THE

ELECTRICAL REVIEW.

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THE

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THE ATTITUDE OF LABOUR.

THE attitude adopted by labour under the advice and leadership of more or less irresponsible men has again come to the front with the Midland Railway Company's order for American locomotives. This order has been given by the company because they have been unable to secure delivery of locomotives from English makers in sufficient numbers and short time to cope with their business. The reason is twofold.

The strike of 1897-8 stopped the English output and delayed work, and the attitude of labour, which lead up to the strike, has during the past few years prevented that natural expansion of English locomotive building which would otherwise have taken place. The American locomotive is a good and cheap though not an economical machine. It is made by men whose wages are not lower than the wages paid in England, though their purchasing power may be less, and the English locomotive ought to be more cheaply produced than the American except for its superior finish and material. At this moment, as a result of the Trade Union Congress in Manchester, a federation of Trades Unions is possible if not actually probable. This is serious news. We do not object to such federation of sensible men, but we feel very grave doubts as to the leaders of the movement. The A.S.E., generalled by Mr. Barnes, will have a big say in the matter, and we all know Mr. Barnes and his ways. Already a case is to be taken up to the House of Lords with a view to reverse the decision of a lower Court that picketing was illegal. We are to have picketing legalised!!!

That a fresh conflict is feared, is the note at all meetings of employers. Mr. Seaton, at Hull, recently told the workmen of that town that either they must alter their ways or the shipyard and engine works must close and go elsewhere. Elsewhere can only be abroad. Mr. Platt, at Manchester, called attention to the mischievous action of both Imperial and municipal authorities in placing all manner of obstructions in the way of employers of labour.

Such authorities tie the hands of English contractors in all manner of ways, and then buy foreign material with no question as to its quality or mode of manufacture. The rights of labour have been sounded so persistently, that there has been no attention directed to its duties. Wealth has its duties as well as its rights. This we are always being told. Labour has rights alone and no duties.

Labour has become pauperised in too many directions. We hear of well-to-do people using the hospitals who can well afford to pay. Mean as they are, they usually have the grace to go in poor clothing. The well-to-do working man does not hesitate to use the free hospitals, and is not even beyond getting up in fine clothes to go in. Workmen in receipt of good wages of 50s. and upwards are in receipt of charity which is denied a poor clerk. It is because one has lost his respect of self, and he takes what is really intended

for the really poor. The same lack of self-respect causes the restriction of output which has so long characterised labour troubles. No man can deliberately loaf away his time and draw good wages and retain his self-respect.

It is to the aggressive attitude assumed by labour that employers' federation owes its being, and we observe that the Employers' Parliamentary Council is taking action in respect of such Bills introduced to either House of Parliament which affect the interest of trade, free contract and of labour, or with respect to the action of Imperial or local authorities affecting in any way the said interests.

It cannot be claimed to-day that the working classes suffer under any disabilities. They have not only all the rights possessed by other classes, but they are exempt from taxation, either intentionally or otherwise, which presses so heavily on the poorer section of the middle class. Income-tax appears to leave them absolutely alone, though it cannot be denied that thousands of them legally come within its scope.

Why should this be? It would be a very useful object lesson if such of them as come within the scope of this tax were made to pay.

Many dock labourers earn their pound daily, and could earn it every day if they chose to do so. Puddlers, iron rollers, and many others have incomes far in excess of many doctors or solicitors and other educated professional men. We are glad to see among the Bills scheduled by the Parliamentary Council named above, the Miners' Eight Hours' Bill; time to be reckoned from bank to bank; the Steam Engines and Boilers Bill, to certificate stokers. The provisions of the Bill will work great injustice, and would shut out the best men. The Boiler Inspection and Registration Bill. This goes too far. Simple registration, as recommended in these columns, is quite sufficient. Let private enterprise continue the good work it has already performed since 1854, whereby in England boiler practice has attained a perfection and security unknown elsewhere.

There are other Bills to be introduced. One is to extend the Workmen's Compensation Act. Already this Act has driven many old men either into the workhouse or upon the charity of their friends, who formerly would have passed an easy and peaceful old age pottering about their old workshops. Such men would be happy at their easy work. Now they are idle and miserable. They owe their misery to Trades Unionism, and the false socialism of such men as Burns and Barnes. Embodied in some of the Bills there are good points. Such good points are swamped by the unreasonable demands which accompany them.

All recent legislation has been conducted as though employers were all simply rolling in wealth, and as though the outer world already were hampered by the same shackles it is sought to place on English industry.

We do not like to be personal, or we could lay our finger upon some of the names of members introducing these various Bills, and point out how, in one instance, the member has transferred his business risks to other shoulders and got clear of his responsibilities, and how, in other cases, the members have no knowledge of the conditions of trade or business.

Among all the restrictions to be placed on employers, we see nothing proposed in the way of restraining a workman from being so drunk all week end that he cannot attend to work on Monday, whereby the employer loses the value of a day's work of a big machine, with interest, rent, taxes, rates, fuel, and shop expenses generally, and possibly penalties on unfulfilled contracts.

The present Government is responsible for the most unfair of all the Compensation Acts, and while neglecting the country's interests abroad, in many instances it has done much to hamper industry at home by its mischievous catching after votes at any price—the inevitable result of party politics. It is about time the business men of Great Britain threw aside their so-called politics, and united on a non-party basis to uphold our industries and shelter them from the insidious attacks of the ill-educated, uninformed leaders of the working classes. It seems hopeless to educate the working class to a sense of facts and to induce them to study economics.

During the 1897 strike John Burns said that if trade were driven out of England the workmen would follow it and do the work abroad. We should enjoy nothing better than to see Mr. Burns and all of his friends working under the paternal oversight of the German Government, and if he and the quarrelsome minority of working men who follow him could be induced to seek work abroad it might not be a bad thing for those who remain. It is from a blatant minority that all the trouble arises.

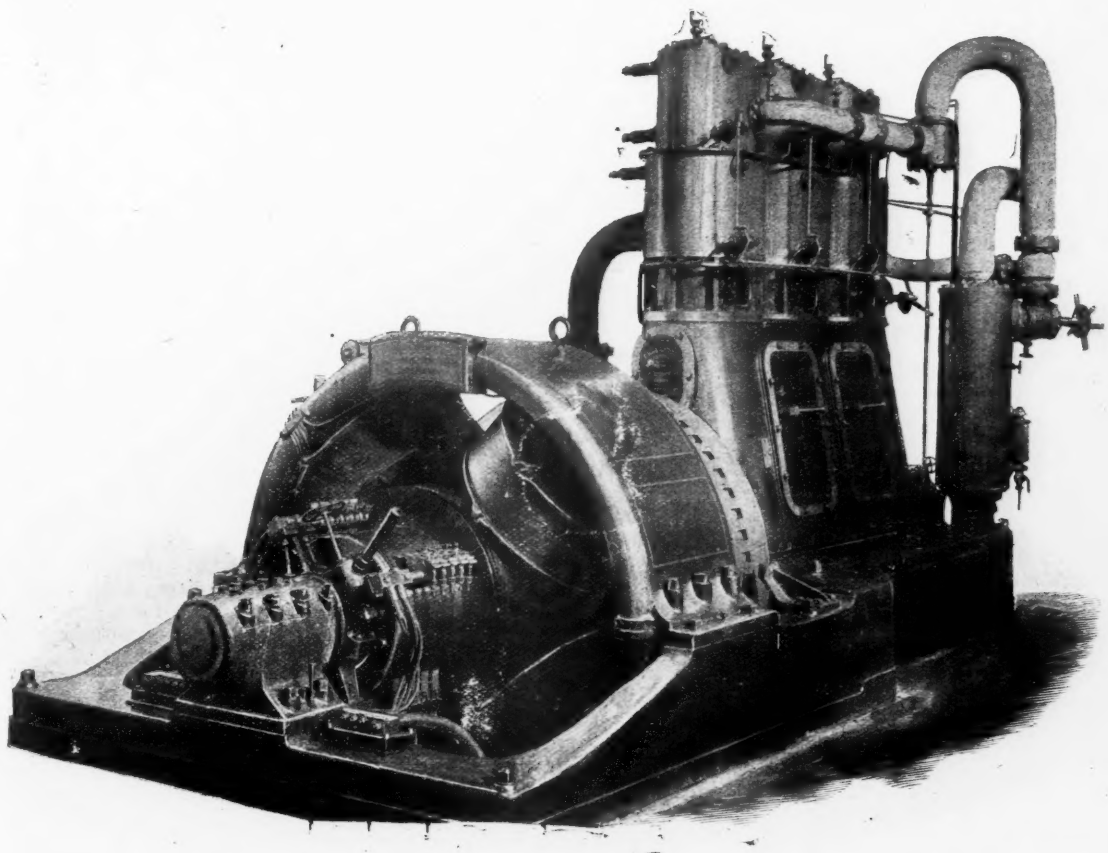
Submarine Cables in War Time.

In a paper read before the Royal United Service Institution on the 7th inst. and entitled "The Lessons to be Learnt, from a Naval Point of View, from the Spanish-American War," Admiral Colomb gave a *résumé* of the cable cutting operations of the war. From the experience gained during these operations, the author drew the conclusion that there is great difficulty in destroying cables, except in shallow water, and stated that according to international law it appeared that an intending belligerent proposing to astonish us by way of dramatic surprise would have to cut all our cables within three miles of the land or else leave them alone. Admiral Colomb also said that it seemed a legitimate conclusion that the ends of our cables ought to be covered and protected by a few of the longest range guns properly mounted in a battery. We give the foregoing epitomised extract from Admiral Colomb's paper, as the gallant officer is a recognised authority on all matters appertaining to naval warfare, and we do this with all the greater pleasure as the opinion expressed is a perfect confirmation of what we have time after time advanced when discussing the value of a trans-Pacific line of telegraphic communication with our Antipodean Colonies. We repeat that the security for telegraphy across the Pacific is almost perfect on account of the depth of water in which the cables would rest, and the easy defence of the landing places; while, on the other hand, the present communication with Australia, lying as it does in shallow water and at our possible enemy's gates, offers a certainty for interruption should war unfortunately break out.

The Colombo Telephone Accident.—A Government inquiry has been held at Colombo into the accident which recently occurred there to three men who received a shock by the telephone wire upon which they were working, being brought into contact with the overhead trolley conductor. Mr. D. Montagu, who held the investigation, has reported to the Government that the accident might have been averted had there been proper supervision, but that this was impossible, as the department is only allowed two telephone supervisers. On the day of the mishap, says the *Ceylon Standard*, they were both engaged elsewhere.

NEW COMBINED PLANT AT SUNDERLAND.

We illustrate a generating set just supplied by the Sunderland Forge and Engineering Company, Limited, for the Sunderland Corporation electricity works. The engine is of the "Belliss" patent, self-lubricating, quick revolution type of 360 I.H.P., and is coupled direct to one of the Sunderland Forge Company's "Pallion" four-pole open type shunt-wound dynamos, having a normal output of 225 kilowatts, at 230 volts, when running at a speed of 365 revolutions per minute. The armature shaft is bolted to the fly-wheel of the engine by means of six 1¼-inch bolts, and at the end remote from the engine is supported in a split bearing 5½ inches diameter × 20 inches long, lined with Magnolia metal, and lubricated by means of three brass rings revolving slowly on the shaft, the lower portion or each ring dipping into a reservoir of oil in the usual way. The plates of the armature core are of the best Swedish charcoal iron, and each stamped in one piece. The armature conductors



are sunk into insulated grooves in the armature core, and the whole construction is such as to render the machine suitable for the supply of power to the projected traction system. The armature is wound with two circuits in parallel, in view of the proposed increase of voltage from 230 to 460. The type of winding is the lap method. The commutator is 24 inches in diameter, and on each of the four brush spindles there are five brush holders of the maker's special design. The rocker is specially massive, and is fitted with both quick and fine adjustment. The terminals at each end of the brush flexibles are of the cone pattern and are drawn home in both the brush spindles and main connectors by means of nuts. The main connectors are placed on the bedplate of the machine, one on either side of the bearing. The magnet coils are wound on metal spools having aluminium flanges, which are arranged with slots for easy slinging. The yoke and magnets are of cast-steel and circular in form, as shown in the illustration. Upon the yoke is mounted a throw-over switch to allow of the machine being either separately or self-excited. There is also a non-inductive resistance provided for breaking the shunt circuit through. The shunt current is 4·9 amperes, and the combined efficiency of the plant at the official test was 88 per cent. at full load. The plant has now been handed over to the Corporation and is supplying power for the town lighting.

ELECTRIC TRAMWAY DEVELOPMENT.

Under the above title, our contemporary, the *Engineer*, prints a column and a half of what would be called a "turnover" on the *Globe*, or a "leader" in the morning daily, for which the lamented George Augustus Sala invented "Daily Telegraphese." That is to say, the development of electric traction is dealt with in regard to some of its very superficial details, from a point of view that allows the writer to touch lightly and elegantly on the fringe of the subject without even a bare mention of the fundamental conditions which, not only in time past have acted as causes to give present results, but as new causes will, in their modern form, mould the electric tramway of the future. The *Engineer* thinks that hitherto traffic has been neglected by insufficient service and slow speed. These are essentials of horse traction, and until electricity can be introduced, must continue to cripple the public benefit of tramways.

Then, again, our contemporary criticises the appearance and want of cleanliness of the ordinary English tramcar—its embellishment with gaudy advertisements to the obscuring of destination boards; the use of its floor as a cuspidor by

objectionable passengers; and the overcrowding that goes on in spite of prosecutions and fines.

These are doubtless topics of an interesting nature to the comparatively small class of tramway managers, and they also, of course, appeal very strongly, in one form or another, to the general public of passengers; but it should be remembered that they are absolutely dependent upon the main conditions under which tramways can be and are operated, and may all be summed up in the one phrase of "efficient management."

What effect or what value has the best possible management on a tramway, founded by private enterprise, whose directors either do not know what the immediate future may bring, or know only too well that their efforts to make the undertaking a success in its struggling youth, will result in its ripe maturity being claimed as a great municipal success.

The conditions affecting the very life and being of tramway enterprise in this country are, and have been, so uncertain that no wonder need be felt at little progress being made. Once let confidence be felt in the prospect of reasonable conditions, and we shall see no more dirty cars covered with glaring advertisements, but an enormously increased service of clean and comfortable electric cars running half as fast again as the crawling horse cars will follow at once, if we are to believe in English progress at all. The fault is not the manager's, but must be laid at the door of those who say how long the manager shall manage, and on what terms he shall manage.

It is time that tramway companies, like tenants, clamoured for fair rent and fixity of tenure, though we fear that no Tramway League will arise to help on the work.

As for municipal tramway management, it can only be regarded as a temporary expedient. The unfettered development of electric lines would mean the growth of interconnecting networks all over the country, which could no more be adequately worked by the municipalities than could our railway systems of 50 years ago. There is no objection to municipalities *owning* the lines within their districts, if there is any peculiar blessing in the sweet sense of ownership; however, it gives them what they have a fair right to ask for, viz., control over the streets. But that they should dream of *working* the extended systems is too ludicrous, too narrow-minded, and too short-sighted for anything.

Their only course will be—and time will show the truth of this prophecy—to lease the lines to some local trust, perhaps both public and private in its composition, which shall, under suitable restrictions, control the entire operation of the local network, and such interchanges of through traffic as the public demands.

THE K R LAW.

In this issue we conclude an article by Mr. Moon examining the mathematical foundation of what is known as the K R law, in which he discusses a very serious discrepancy between the conclusions derived by Lord Kelvin and Mr. T. H. Blakesley from the same premises. Fortunately the discrepancy rests only on a mistake of Mr. Moon, who has quoted Mr. Blakesley with insufficient care, and has compared the expression given in "Alternating Currents of Electricity" for the current received at the end of an earthed cable, with that used in a different problem for the alternating E.M.F. applied to a cable of infinite length. This error deprives Mr. Moon's calculations of any value, but has led him indirectly to a discussion of a point of some interest. It is the exact meaning of the K R law.

The conclusions of the ordinary theory of the propagation of alternating currents through a cable possessing capacity and resistance, so far as they concern us here, are as follows:—

If an alternating E.M.F., $E \sin \omega t$, be applied to one end of a uniform cable having capacity, K, and resistance, R, whose other end is earthed, the alternating current passed into the sending end has an amplitude, C_s, and that at the earthed or receiving end an amplitude, C_r, where

$$C_s = \frac{E}{R} \frac{\beta}{\sqrt{2}} \left\{ \frac{\cosh \beta + \cos \beta}{\cosh \beta - \cos \beta} \right\}^{\frac{1}{2}}, \qquad (1)$$

and

$$C_r = \frac{E}{R} \beta \left\{ \frac{1}{\cosh \beta - \cos \beta} \right\}^{\frac{1}{2}}, \qquad (2)$$

and

$$\beta = 2 \sqrt{K R \omega}.$$

It may be seen that

$$\frac{C_s}{C_r} = \left\{ \frac{\cosh \beta + \cos \beta}{2} \right\}^{\frac{1}{2}},$$

while ω is a measure of the speed of alternation.

The last equation, due in this form like the others to Mr. Blakesley, contains the K R law. He states that the attenuation of an alternating current sent through a cable depends only on the quantity, β, *i.e.*, on the product of the K R, and the frequency of alternation. It leads directly to the proposition that the rate at which a series of charges may be passed into a cable to produce an effect of a certain size at the far end is inversely proportional to the K R. Lord Kelvin in his early work on this subject discussed the propagation through a cable of a definite charge suddenly introduced at one point, as Fourier had done with a definite quantity of heat introduced at one point of a metal rod. His conclusion that the rate of propagation varied inversely as the K R led him to enunciate the law.

Now, apart from his error in quotation, the problem that Mr. Moon has discussed on the strength of Mr. Blakesley's expression for the received current is quite different. He calculates the speeds that may be obtained from cables on the assumption, not that the charges passed in from the sending end are the same in all cases, but that the E.M.F. at the sending end is the same, so that the charges increase with the capacity. The rule propounded for the best construction of a submarine cable, namely, that $\frac{D}{d}$ should equal $\sqrt{e}$, only holds when the sending charges are given. If the sending E.M.F. is given, the proportions of the cable to obtain the best speed will be different, since every increase of the capacity then acts in two ways. It reduces the resistance by making room for a larger conductor, and increases the size of the charges taken from the battery. It would seem that on this assumption it would pay to increase the capacity even beyond the large figure given by the rule referred to above which makes K R a minimum. To treat this problem analytically, equation (2) must be solved by taking a fixed value for C_r, viz., the minimum amplitude that gives a readable signal, a fixed value for E the E.M.F. of the given sending battery, and then determining the diameter of the cable conductor to give a maximum value for ω.

But why the E.M.F. of the sending battery should be fixed is not easy to see. If anything is to be defined, other than the sending charges, it should be the strain on the dielectric at the sending end, and this would involve the reduction of the battery power with the reduction of the thickness of insulation. The solution then requires an expression to be introduced for the strain on the dielectric of a charged cable. It is worth noticing that the condition of constant charges involves a reduction of the battery power with the thickness of the insulation, though not, of course, in such a way as to keep the dielectric stress absolutely the same for all capacities. Considerations of this kind might lead to several interesting analytical problems.

STORAGE BATTERIES: IMPROVEMENTS DURING THE LAST HALF DECADE.

Mr. Joseph Appleton, who, if we mistake not, was some 10 years ago a member of the London firm of Appleton, Burbey & Williamson, and at one time a pupil of the veteran electro-chemist, Mr. Desmond G. Fitz-Gerald, has quite recently read a very interesting paper on the above subject before the New York Electrical Society. Until the year 1894, he says, the use of storage batteries in America had proved most disastrous to all concerned. The main reasons for this are summed up as follows:—

1. The batteries were poorly designed.
2. No attention was given to the mechanical features; the

main idea being to get the greatest capacity for the lightest weight.

3. The batteries were much over-rated; their full capacity being given as their normal working capacity.

Moreover, the storage battery business was, prior to that date, in an unsatisfactory and weakly condition. Litigation was the principal cause of this; the fear of protracted and costly lawsuits prevented capital from being invested in the business, and frightened prospective users from purchasing.

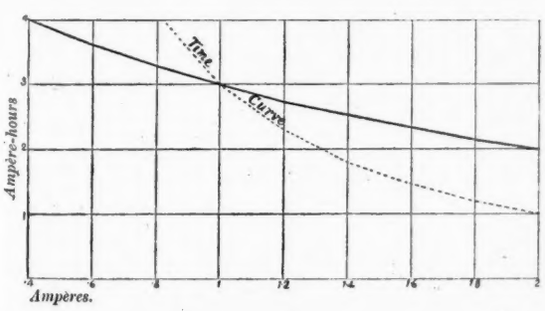
The conditions, says Mr. Appleton, are now very different. All the disturbing elements have been removed, and the business has been put on a proper and substantial basis. The result is shown by the following figures, giving the weight of battery plates manufactured in the United States in the years specified:—

1894	...	...	...	349,000 lbs.
1895	...	...	...	1,112,800 „
1896	...	...	...	2,215,300 „
1897	...	...	...	3,607,300 „

The figures for 1898 have not yet been arrived at; but, it is stated, they will show that the use of the storage battery is progressing more rapidly than ever.

Contrasting mechanical generators of electrical power with the storage battery, it is pointed out that the latter is, practically, not liable to sudden interruptions by breakage or injury; and this fact constitutes one of its greatest recommendations. An overload has not the same effect on a storage battery as on a mechanically-operated generator. For a short period, an overload, even of great extent, does not injure a storage battery. It causes more rapid chemical action, but this, if not continued too long, or repeated too often, does not appreciably injure a well-made storage cell. Moreover, if the overload be too long continued, this does not mean the sudden failure and collapse of the battery, and complete interruption of the output, though it results in the premature depreciation of the battery plates. This may be unnoticed for months or even years. The modern storage battery is designed to stand occasional extreme discharges, and to do so without injury.

Mr. Appleton next considers the question of the rates of charge and discharge of storage batteries, and their capacity at different rates. These vary somewhat with different types of battery, but not to a great extent—a statement which, with certain limitations, may be accepted as true at the present moment, though it would have been in contradiction with fact only a short time ago. The more rapidly you discharge a battery, the smaller is its available capacity; and Mr. Appleton gives the following curve as illustrating generally the increase of apparent capacity as rate of discharge is diminished.



In this curve the ordinates express capacity in ampere-hours; whilst the abscissæ, instead of expressing time of discharge in hours—as is usually the case—represent rate of discharge in amperes. Thus the time of discharge, varying from 10 hours to one hour, will be the quotient of the ordinate by the abscissa at any point in the curve. We have indicated a portion of the time curve by a dotted line. It is only within the last few years that a one-hour discharge has been possible; and it is very largely due to the fact that storage batteries can now be discharged at such rapid rates that their use has been growing so rapidly.

In large engineering applications, as Mr. Appleton observes, the storage battery is used chiefly to supply large amounts of electrical energy for short periods, and by increasing the allowable rate of discharge the size of the battery required is proportionately reduced. There is a prevalent idea that, if the capacity of a battery be virtually reduced by rapid discharge, the efficiency is correspondingly impaired. This, says Mr. Appleton, is not the case at all. It is only the available capacity of the battery that is reduced by polarisation. From the point of view of practice he is not far wrong; but, in regard to the energy efficiency at least, it has, we think, been ascertained that, when the discharge is so rapid that the acid becomes exhausted in proximity to the anode within the cell, and when, consequently, oxide instead of sulphate of lead is produced by the reduction of the peroxide of the metal, a considerable loss of electrical energy occurs—the *subsequent* combination between oxide of lead and sulphuric acid being ineffective in the circuit and generating energy in the form of heat. Moreover, as is pointed out, a high rate of discharge results in a higher $C^2 R$ loss of energy, *i.e.*, an increased generation of heat in overcoming the internal resistance of the cell.

In the days preceding the last half decade, manufacturers were anxious to jump at every opening for the use of a storage battery, whether the conditions warranted it or not. In order to do business, they accepted contracts drawn entirely from the purchaser's point of view, without regard to the capabilities of the apparatus; and they guaranteed results which, to say the least, were extremely difficult to realise. Now, as Mr. Appleton points out, things are entirely different. The business is on a commercial basis; and it is not a question of getting an order at any price, but of securing business which will prove satisfactory and permanent. Manufacturers now insist on proper conditions for the working of their batteries, and, in their absence, decline to supply them. "This," says the writer of the paper, "is as it should be; and I think I am perfectly justified in saying that, during the last four or five years, there has not been a storage battery installed in this country except under conditions which justified its use." The only applications to which this statement may not apply do not come under the head of ordinary supply, being of an experimental character, and, presumably, on a small scale. In the United States, owing to this method of doing business, confidence in storage batteries has been regained, for it is now realised that, when storage batteries are installed and worked under suitable conditions, the result will invariably be satisfactory.

As Mr. Appleton rightly observes, "The trend of electrical engineering is to-day toward the concentration of generating machinery, the highest possible economy in operation, and the utilisation of motive power and generating machinery to the fullest extent, so that the investment may produce the greatest return. These conditions make the storage battery indispensable, for without its aid it is impossible to maintain a constant load on the power house." In the supply of electrical power, there are, as we know, periods of maximum output, or "peaks"; and, even when power for various different applications is supplied, the peaks can never be regulated without the aid of the storage battery, so as to give a tolerably level load line. On the contrary, as is particularly noticeable in the case of a traction and lighting load, the peaks have a tendency to occur at about the same time.

Moreover, the concentration of generating machinery means an increased area for distribution and the necessity for sub-stations in order to reduce expenditure for conductors, and experience shows that in the majority of cases it is more economical to use storage batteries than to meet the cost of the copper that would otherwise be necessary. This fact, in addition to the advantages realised at the power house, indicates that the storage battery will play a most important part in problems relating to the distribution of electrical power. It is, indeed, of such importance that conditions suitable for its utilisation must be considered in the original design for distribution; whereas, in the early days, the storage battery was utilised only as a makeshift and to remedy difficulties as they cropped up.

In America, Mr. Appleton points out, storage batteries are subjected to much more severe work than they are in Europe, where they are looked upon as holding a reserve of power,

and are not supposed to be discharged at their maximum rate every day, and, perhaps, twice on some days.

"As an example of this," says Mr. Appleton, "I will tell you what one of the Tudor Company experts from Germany said when he was over here last spring. He was attending the National Electric Light Convention at Chicago, and one of the features of that Convention was the large storage battery plant which the Chicago Edison Company had recently installed. During one afternoon while the Convention was being held, a very heavy thunderstorm came on, and the battery was called upon suddenly for its maximum rate of discharge, and the full rated capacity was taken out. The maximum rating of this battery was a complete discharge in one hour. Our German friend thought that was doing pretty well, but when I told him that this storage battery was installed under contract, which allowed it to be discharged at this rate every day during the winter, he was horrified, and said: 'You must not let them work the battery in that way! Tell them they must hold it in reserve.' We told him that if we did that we should not be able to do any business, and that we simply had to meet these conditions, and could do so without any difficulty." This example explains why the maintenance of accumulators is undertaken in Europe at a lower figure than is obtainable in America; but it also suggests that we may find it possible here to get more work out of the storage battery than we have done in ordinary practice.

NERNST LAMP v. THE ARC AND INCANDESCENCE LAMPS.

By JOHN I. HALL.

A CONSIDERABLE amount of interest has been aroused by the claims put forward by the promoters and others interested in the development of the method of utilising refractory materials for incandescence lamps. A favourite illustration as to the merits and advantages of the Nernst lamp is for the promoters to parade the Welsbach gas mantle, declaring that the Nernst lamp will occupy the position in electric, that the Welsbach system does in gas lighting.

If this statement is considered on the merits of the Welsbach mantle, then there is only the advantage of increased illumination to be secured by adopting the Nernst lamp for electric lighting, because it is a well-known fact (a fact that the writer has verified by inquiries of various users of the Welsbach mantle), that in lighting by ordinary gas burners *versus* the Welsbach mantle plus the cost of upkeep, the cost is not in favour of the Welsbach system. After considering the matter, the writer has come to the conclusion that the claims for the Nernst lamp must be modified.

In certain circumstances the Nernst lamp will occupy the position of the Welsbach mantle, for in many cases if it is a lamp to last only 500 hours and requires the changing of the refractory material at a cost of 2s. 6d., it will supersede the carbon incandescence lamp, but it can never compete with, nor supersede, the arc lamp, without the makers can produce it to give 1 C.P. for an expenditure of 0·4 watt. Should they succeed in producing the lamp to do this, then not only the whole field of illumination now occupied by the carbon incandescent and arc lamps will be at their disposal, but the whole system of gas lighting would be superseded. But at present the position of the various illuminants may be summed up as follows:—

1. The Welsbach system is an advance over the ordinary method of lighting by gas.
2. The enclosed arc lamp is an advance over the open arc.
3. The Nernst system is an advance in incandescent lighting.

The electric lamps are placed in the order they will occupy in regard to cost of maintenance, for as the Nernst lamp supersedes the enclosed carbon lamp, so does the arc lamp supersede the Nernst lamp.

Mr. J. Swinburne, in the prospectus of the Nernst Electric Light, Limited, states that: "It will, I believe, oust the arc lamp in nearly all cases." On examination it will be found that it will not oust one arc lamp at present in use as the following particulars will show.

The Nernst lamp is said to give 1 C.P. for an expenditure of 1·5 watts. The arc lamp (2,000 N.C.P.) absorbs 500 watts and actually gives 1,200 C.P. The Nernst lamp to give 1,200 C.P. will require an expenditure of 1,800 watts, or 3·6 times more energy than the arc lamp. 1,800 watts = 1·2 kilowatts per hour which will cost to the consumer 3·6d. per kilowatt per hour.

The arc lamp absorbs 0·5 kilowatt per hour, and this at 3d. per unit equals 1·5d. These figures are for public lighting; for private consumers the cost is, of course, increased. Allow a liberal amount for carbons, trimming and cleaning, &c., say, 0·5d. per hour, then there is 1·5 + 0·5 = 2d. per hour as the cost of the arc lamp against 3·6d. as the cost for the Nernst lamp.

The figures given above are for the open arc lamp, but for the enclosed arc lamp the cost would be about 1·6d. against 3·6d. for the Nernst lamp. In other words, instead of our corporations running their street arc lamps for, say, £18 per annum per lamp, they will, by adopting the Nernst lamp, run them at £64, or spend £46 more per lamp.

It will therefore be some considerable time before the municipal electrical engineer is found who will be ready and willing to come forward and suggest the ousting of the arc by the Nernst lamp.

The Nernst Electric Light, Limited, prospectus further states that "there is no difficulty in running in parallel on 1,000-volt circuits without transformers." It will be of some interest to the electric light engineers to find the 1,000-volt circuits without transformers amongst the electric lighting stations. However, the merits of the 1,000-volt lamps can be considered as against the arc lamps.

Suppose the advantages of the Nernst lamps are considered running in parallel on 1,000-volt mains. Is there any economy in conductors to be secured under these circumstances? Take a section of, say, 20 arc lamps, with transformers, running in parallel and controlled from a sub-station. The current required will be

$$\frac{20 \times 500 \text{ watts}}{2{,}000 \text{ volts}} = 5 \text{ amperes primary current.}$$

For 20 Nernst lamps the current will be

$$\frac{20 \times 1{,}800}{1{,}000} = 36 \text{ amperes primary current.}$$

Thus it will be seen that, taking the most favourable conditions set down by the prospectus of the company for the Nernst lamp to compete with the arc lamp, a cable of seven (7) times the sectional area will be required, in addition to the transformer, for them to run on existing installations where the E.M.F. is 2,000 volts.

The cost of the lamp cases and posts now remains to be considered. It may be taken that the lamp-posts will cost about the same in both cases. The arc lamp complete, with hood and globe, costs, say, £6, and the Nernst lamp £1. This appears to be a fair price, allowing for promotion anticipations without actual figures as to cost.

The first cost, and maintenance for 12 months, may now be considered, voltage 2,000 lamps in parallel:—

Arc lamp and transformer, say	£12	0	0
Say cost of cables	3	0	0
Maintenance for 12 months	18	0	0
Total cost	£33	0	0

Nernst lamp and part cost of transformer situate in sub-chamber (voltage 2,000 to 1,000)	£3	0	0
Cost of cables	21	0	0
Maintenance for 12 months	64	0	0
Total cost	£88	0	0

There are other considerations of cost, such as conduits, depreciation and interest on capital outlay, which the electric engineer will observe are not in favour of the Nernst lamp, and so they are, in kindness, omitted.

To summarise the foregoing particulars, it is pretty plainly to be seen that the rosy and light-hearted view taken by the Nernst Company as to ousting the arc lamp will need some slight modification, especially on the score of first cost and economy. Unfortunately for the new comer there are such things as cables to be taken into account and maintenance.

So, then, the manufacturers of open and enclosed arc

lamps are not yet to put up the shutters, stop the machinery, and discharge the workmen; but it is not so pleasant an outlook to the carbon lamp manufacturer unless he commences to make the Nernst type of lamp (under license, of course) or improve the carbon lamp, as will appear later on.

But there are other considerations to be taken into account where the advent of the Nernst lamp will be most beneficial, and where it will be appreciated, as we shall have for street lighting two illuminants to choose from, and where one is not applicable the other will be most serviceable.

It may be considered that for lighting large areas such as squares, public markets, &c., and main streets and roads, the arc lamp will not be superseded, but for the lighting of narrow streets, public halls, &c., the Nernst lamp will be a most valuable acquisition, on account of the increased economy in running.

In all the circumstances it must be considered that the lamp is automatic in its action, as the match-assisted lamp is out of question in 1899, excepting, of course, to the promoters. The engineer and manager of one of the most successful gas works in the country said to me, when discussing the merits of the Nernst lamp: "Why, you will be going back to the old barbarous times of gas lighting if you use a match to light your incandescent lamp, and all the advantages of the enclosed filament lamp will be dispensed with."

(To be continued.)

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At the meeting of the Institution of Electrical Engineers on Thursday evening of last week, the discussion on Mr. Marconi's paper dealing with wireless telegraphy was resumed. Prior to the resumption of the discussion a demonstration of Dr. A. Wehnelt's current interrupter for Ruhmkorff's coils was given by Mr. Campbell Swinton, who referred to the difficulty experienced in obtaining a continuous train of Hertzian waves, as the ordinary make and break on an induction coil gave waves separated by an enormous distance or interval in comparison with the duration of the wave. With a Tesla coil the waves lasted $\frac{1}{30000}$ second, and were followed by intervals of $\frac{1}{200}$ second, although the coil was supplied by alternating current of 100 cycles. In a diagram, if the waves of, say, a maximum of five oscillations took up 10 inches, then the succeeding space must be no less than 208 feet. It was impossible to tune or syntonise when the gap was so great. By means of the Wehnelt electrolytic contact breaker it was easy to get discharges at the rate of 1,000 or more per second. The contact is made and broken at a platinum wire dipping into dilute sulphuric acid, the current must be alternating. Mr. Swinton characterised the arrangement as the first real advance made for a very long time, the advantage gained being the obtaining of continuous interruption at very high frequency. Mr. Tremlett Carter suggested that the effect might be due to an electrically-driven Trevelyan rocker action, but Dr. Thompson, who occupied the chair, added that there was clearly something of the nature of a resonance effect, and reminded the meeting that the capacity of the polarised electrodes might have something to do with it, and cited a paper by Cromwell Varley on the capacity of polarised electrodes. The demonstration was striking, and attracted marked attention.

Mr. Gavey desired, in re-opening the discussion on Mr. Marconi's paper, to congratulate the author on the advances he had made in the last 15 months. He was happy in having been associated with Mr. Marconi in the early experiments on the Bristol Channel. The apparatus then was untried, but crude, and a little uncertain in its action. A further series of experiments near Dover was made, with the object of ascertaining the law of height and distance, and testing the system as a practical system. The results led to certain conclusions; thus they proved the law of the lengths squared of the wires (*i.e.*, that the distance covered varied as the square of the length of the vertical wires, if they were of equal length), and, further, they proved that with vertical elevated conductors syntony did not come in at all. Thus the distance covered was found to depend upon the product of the lengths of the wires, equally good results being obtained with vertical conductors 70 feet and 36 feet high respectively at the two stations, as with wires each 50 feet high:—

$$70 \times 36 = 2{,}500 = 50^2.$$

More marked effects were found if a capacity was placed at the top of the vertical conductor, and the transmitter was allowed a lesser height of conductor. A greater height of conductor was required over land than over sea. He believed similar results had been found by the author at Spezzia. If 35 feet height of wire transmitted signals over 1 mile of water, 50 feet was barely sufficient over the same distance of land. Subsequently some experiments at Charlottenburg gave similar results in the hands of German investigators, when the difference was attributed to dust particles floating in the atmosphere. There could not, however, be such a marked difference between the atmosphere just over the sea and just over the land, and he thought that the variations must be accounted for by the reflection from the surface of the water, which acted as an even plane or floating mirror.

He asked if the reduced height of wire given as 20 feet was the practical working height, or whether this was the shortest height which enabled signals to be sent and received with skilled experts at each end. On the question of earthing, he had disconnected the earth at the coherer and substituted a coil of wire, finally reducing the capacity to that of a strip 2 feet long and 1 inch wide, but when the earth was disconnected at transmitting end he could not get good signals. Oil in the transmitter seemed quite superfluous when the vertical wire was provided. Good signalling appeared to depend upon frequency rather than upon energy; with a large coil capable of giving a 20-inch spark, with 5 amperes, and 6-inch spark gap, better results were obtained than with 10 amperes and 20-inch spark, owing to the more rapid vibration with the smaller current. Reflectors had also been tried, up to half a mile results were attained, but beyond that they were disappointing, and the experiments were afterwards abandoned. From Mr. Marconi's paper he gathered that satisfactory results were now obtained from reflectors up to 2 miles, and he hoped it was want of time only that prevented further details being given. The use of reflectors would remedy the trouble of several adjacent receiving stations being practically in permanent contact with a transmitting station—any message sent being heard at all the points.

Finally, he asked for some particulars of the method of screening the apparatus from the violent surgings produced by the transmitter; and, second, how the apparatus was guarded against lightning troubles; it was obviously an undesirable thing to introduce large atmospheric charges into many places where the apparatus would be placed.

Mr. O'Gorman wanted to know if the coherer had been proved to work only with waves or whether minute differences of potential suddenly set up by earth conduction, &c., might not set off the coherer. The true action could be proved by carefully reflecting Hertz waves away and ascertaining whether any signal could be read.

After a brief remark by Mr. Tremlett Carter, Mr. Granville asked whether if 100 Obach cells were used as battery power these were used to charge an accumulator for running the coil. With reference to the screening effect touched upon in the paper, it was stated in other descriptions that three men-of-war had not prevented the receipt of messages—was this so? Again, do walls cut off or screen the effect?

Mr. Miller remarked he had used several spark gaps in series. He asked what was really the best metal for contacts. A coherer breaks down with a certain wave and does not break down below that. Presenting a metal bar to the coherer will, however, often cause it to act. Mr. A. A. C. Swinton stated that X rays did affect the resistance of carbon. Mr. Brown corroborated the statement, and believed that while one wave would reduce the resistance of carbon, the resistance would tend to fall with time.

Dr. S. P. Thompson put some questions to Mr. Marconi, but also thought that although the advantages in earthing had been touched upon, one advantage had not been pointed out. It was, that the earth directly below acted as a mirror analogous to a mass of iron brought up close to

the end of a solenoid (as given in the well-known paper on "Mirrors of Magnetism," *Pro. Phys. Soc., London*, a few years ago). Electrical oscillations take place up and down the vertical wire; by earthing, its length is practically doubled, and the earth acts like an equal length down below; the effective length is increased by $\sqrt{2}$ times, compared with that if not connected. Some interesting and useful optical analogies were then introduced, and the reason why the wire should be vertical was stated. Horizontal vibrations more readily degenerate into heat; the conductivity of land is greater than that of water. Waves parallel to the surface of the earth are reflected; those which are vertical dive into the earth and are refracted. Again, reflectors are of no use if put within $\frac{1}{4}$-wave length from oscillator; if the wave length is, say, twice as long as the vertical conductor, the reflector becomes enormous and impracticable. One must keep these principles in mind.

Mr. Marconi, being absent through indisposition, had written to say he would reply after the repetition of his paper on the 16th inst. in the Lower Exeter Hall.

Prof. Ernest Wilson then read his paper on the "Induction Motor." The discussion consisted of a single contribution from Mr. Mordey, who confessed time had not permitted him to follow the paper, but was glad that the ordinary theories of self-induction did not fit, and considered the paper would help self-induction theorists to modify their theories.*

It was announced that the paper at the next ordinary meeting would be by Mrs. Ayrton, on "The Hissing of the Electric Arc."

CORRESPONDENCE.

The Kilduchevsky Mega Telephone.

I am sorry that you don't mention that *I* have sent Mr. Bennett's report "to arrive at the true elucidation of the matter in dispute."

Some time ago two photos. of the pencil and granular Kilduchevsky transmitter, together with a description and extract from the report of Mr. A. R. Bennett, was sent to your valuable paper. Unfortunately, the figures were not correct, viz., the words, "With an ordinary double-pole receiver the conversation of any description could be carried on without effort," ought to refer to 11,861 and 24,666, not to 35,508 K R.

The report given by Mr. A. R. Bennett to the Kilduchevsky Mega Telephone Syndicate is an extremely favourable one, and surely did not want to be "garbled." To be best understood, let us use the exact words of Mr. Bennett's report:—

"On February 9th I carried out a series of experiments on an artificial cable, in which the essential electrical conditions of a modern Atlantic telegraph cable were accurately reproduced.

"For purposes of comparison, *two of the most efficient telephone transmitters in general use* were pitted against the Kilduchevsky. Both had been previously tested to make sure that they worthily represented their respective types.

"In the first instance, it was sought to ascertain the suitability of Kilduchevsky for the ordinary short-distance work in subscribers' offices.

"For this purpose all three transmitters were tried through two sections of the artificial cable, representing about 69·5 miles of actual core, an ordinary double-pole Bell receiver being used at the receiving end.

"Tested successively with two, three and four ordinary dry cells, such as are commonly employed by the National Telephone Company for transmitter work, all three transmitters proved of equal efficiency, no difference in the strength or clearness of transmission being observable.

"On increasing the battery power to six dry cells, the *Kilduchevsky became perceptibly louder than the other two.*

"On bringing another section of cable into circuit, raising the total to about 112·8 miles, with a resistance of 342·9 ohms and a static capacity of 34·62 microfarads, the product being 11,861, the *intensity of the ordinary transmitter was much reduced, and the Kilduchevsky became markedly the best of the three.*

"The usefulness of the Kilduchevsky *with ordinary subscribers'* cells having been demonstrated, attention was directed to its adaptability for long-distance transmissions.

Six small E.P.S accumulators, substituted for the six dry cells, *had the effect of increasing the volume of sound without impairing the clearness of transmission.* With 112·8 miles in circuit and with an ordinary double-pole receiver, speech was *loud and clear* and of such a character that conversation of any description could be *carried on without effort.*

"The cable in circuit was then increased to about 162·9 miles, having a total resistance of 495·2 ohms and a static capacity of 49·81 microfarads, the product of the two being 24,666. The volume of sound was reduced, but the speaking continued quite good enough *for easy conversation.* Names and prices of stocks *read* from a newspaper could be *followed without* difficulty."

You say that "it is unfortunate that Mr. Kilduchevsky did not say of what type two of the most efficient transmitters were." Well, the two transmitters were of the Hunnings Granular type largely used in this country and on the Continent for long distance work, but is it fair to give their names, once they have been beaten? I don't think so. But is it a matter of type; on different occasions my transmitter was tested with different American long-distance transmitters of the same type that are at present used on the longest lines in the world, still the "Kilduchevsky" has proved itself to be the most efficient.

There is no mystery why it is so, once the "burning" and "packing" difficulty have been overcome, and currents of such strength could be induced in the secondary of the coil that a strong spark could be produced and a Geissler tube been lighted by speaking into the transmitter.

I hope this letter will be to yours and Mr. Bennett's satisfaction; as to myself, I am content with the opinion of Mr. Bennett that "the results actually obtained show the Kilduchevsky transmitter to be superior for long-distance transmitters to any in general use." (See Mr. A. R. Bennett's report.)

Paul Kilduchevsky.

March 7th, 1899.

Absolute Block System of Signalling on Railways.

Being the inventor of the absolute block system of signalling on railways, I observed lately some remarks in your journal in connection with the system. I have examined all the works upon railway block signalling, &c., and find that all the systems described by the several authors are incorrect. In Mr. Pigg's work, "Railway Block Signalling," it is stated that "With absolute block working two trains on the same pair of lines are not permissible. With the permissive block any number of trains up to a pre-arranged limit may be admitted into a section. This is not the present system of "absolute block," it was the system in use prior to my publication in 1865, which system I then condemned as useless in foggy weather, and is mentioned in the Government report prior to 1865 as the system then in use. This system is also mentioned in Sir George Findlay's work on the "Working and Management of an English Railway," and also in "Block Signal Operation," by W. Le Derr, superintendent Delaware division of the Erie Railway. In "Safe Railway Working," by Mr. C. E. Stretton, it states "Line clear" must not be given until the train has passed at least a quarter of a mile beyond the *signal-box*, not a *signal-post*; also "Train out of section from the post in advance, no train must be allowed within a quarter of a mile ahead of the home signal." This is not correct. It was the old system before the starting signals were put down. With the present absolute block system "Line clear" must not be given till the train has passed the starting signal, also that a train must not enter a station section whilst the preceding train is in the intermediate section in advance, that is, the section between the railway station, if there are not any advance starting signals. The absolute block system is that an empty section must be maintained between all trains by Act of Parliament, so that if in case of a fog, should an engine driver overrun the stop signal, he has the empty section in front of the signal he has passed, which will allow him time to stop his train by the time he reaches the second stop signal. This is the object of the absolute block system. With the permissive block system

* We believe Mr. M. B. Field will contribute some interesting remarks to the *Journal* on this paper.

in fine weather, a driver is allowed in the empty section, with the caution signal "Section clear and station or junction blocked," thus showing that the statements in the various railway works are incorrect, and furthermore, that these regulations are published in the various railway works by their authors, which I am very much surprised at.

In 1865 it was stated in the papers that it was impossible to work the railway traffic in foggy weather without collisions. I wrote to the late Sir D. Gooch, who considered my system of signalling too costly and complicated. I was at that time an apprentice on the Great Western Railway. I published my invention in the *English Mechanic*, December 29th, 1865, and have lived to see my invention made compulsory throughout the United Kingdom, a remark that no other person in the kingdom can make. In 1866 I forwarded my system to the signal manufacturers. They informed me I had been anticipated by another inventor. Twenty years afterwards I found my system exhibited at the Inventions Exhibition. I made inquiries, but could not find out who was the inventor. I searched the Patent Office, and found out the other inventor had taken out six patents, but could not work the traffic in foggy weather.

As I had received a circular from the Prime Minister in 1870, which was published in the paper, 1869, that inventors would be compensated by the State if the invention was adopted in the service, or substantial benefit to the public had resulted from it, in 1886 I wrote a letter which the Prime Minister forwarded to the Board of Trade. They replied that the circumstances connected with the introduction of block signalling did not appear to the Board of Trade to be such as to enable them to entertain the application. I again wrote the Board of Trade for a settlement or an interview. They replied, June 4th, 1897, that they must refer me to their previous communication upon the subject; as I had demanded £50,000 from the Board of Trade in accordance with the circular, I have now offered to accept any terms they think proper to make. The country can do without me, but not without my invention, and by my invention I have saved more lives than any other person in the United Kingdom, and "every man expects to be rewarded for his duty to his country."

Christopher J. Little,
Member Society of Arts.

"Railway Block Signalling."

Common courtesy demands a notice from me of my reviewer's letter in your last issue. Otherwise I should not have troubled you further.

I regret that Mr. Langdon, having written the review anonymously, should now disclose his identity. With Mr. Langdon, of the Midland Railway, vice-president of the Institution of Electrical Engineers, and author of "Applications of Electricity to Railway Working," I am not concerned, although it is probably intended that his personality shall overshadow that of an unknown like myself.

With the reviewer of "Railway Block Signalling" in your columns I am more concerned, and whilst I am glad to see that he now makes several corrections as the result of my letter in your issue of February 24th, I must express surprise that the remarks respecting the inferred consultation of works on kindred subjects without acknowledgment have been neither justified nor withdrawn. But for this it is possible that I should never have entered your "Correspondence" columns, although such a review in your paper could scarcely fail to have a most damaging effect upon any publication and its author's character.

There are other matters in the review which might have been corrected at the same time with advantage, and the letter in your issue of 10th inst. is not quite free from special pleading on certain points. I am, however, perfectly content to leave the matter as it now stands. Your readers can readily judge, if they wish, of the care exercised by the reviewer, of the value of the review as an index of the contents of the book, and of other matters connected therewith, since, by your courtesy, I have had the opportunity of reply.

J. Pigg.

37, Union Terrace, York.
March 11th, 1899.

Wireless Telegraphy.

In looking through an early volume of the Telegraphic Journal I came across the following paragraph, which, in view of the prominence now given to wireless telegraphy, I think may prove of interest to some of your readers:—

"Aerial Telegraphy.—Prof. Loomis continues his experiments in telegraphing through the upper air by means of natural currents of electricity and without the use of wires. He has built towers on peaks of the West Virginia mountains 20 miles apart, and erected metal rods from these as electrodes to pierce the electric strata of the air, and with telephones in this aerial circuit he can converse a distance of 20 miles?"

The vertical conductor wire of Messrs. Edison, Tesla and Marconi, seems to be quite an old-fashioned affair after all.

E. Bennett Viles.

P.S.—The volume of the Telegraphic Journal is for the year 1879, and the paragraph is on page 87.

The Institution Ethics.

If I remember rightly some few years back you had an editorial on a paper read before the Institution of Civil Engineers upon the subject of electric welding, in which, if I also remember rightly, you questioned the ethics of the production of such a paper before such an Institution. What, therefore, can be said of an Institution which, after having had read to it a paper of the same class, becomes so hysterical at the sight of a packed Institution that it circularises its members (and so advertises the company concerned) to attend at a second meeting to be held upon another day, in another hall, to hear the same paper and bring their friends.

Apropos of the question, the following incident is instructive and at the same time amusing:—

Scene. One of the doorways into the theatre of an Engineering Institution, the same being packed with a mass of humanity. Enter into the doorway beneath a festoon of trousers, legs and boots, three gentlemen evidently from the City who attempt to elbow their way through the mass without success, one of them in an indignant tone of voice inquired, "Are there no seats on the platform for the directors?"

Bystander (equally indignantly): "Seats on the platform, there's no bally platform, much less seats."

X.

High Voltage Circuits.

It has occurred to me that in some special cases it would be advantageous, on a 220-volt circuit, to run a group of lamps in series—say, for instance, the lights over a billiard table, which are always switched on together. Would it not be more economical, both in lamps and current, to run eight 27-volt 16-C.P. lamps in series, instead of the eight 220-volt 16-C.P. lamps in parallel? Has this been tried?

A 16-C.P. 220-volt lamp is a very unsatisfactory thing at the best.

E. Bennett Viles.

The Postal Telegraphists.

The other evening Mr. Hanbury, from his place in the House, made a very clever speech in defence of the Post Office administration. It was clever not in substance, but in glib plausibility. It was a marvellous exhibition of dust throwing, and the fact that 91 members voted against Mr. Hanbury, including two members of his own party, is a splendid testimony to the vigorous way in which the Parliamentary secretary of the telegraphists has opened the eyes of members to the real facts of the case.

Some of the statements made by Mr. Hanbury are curious; some even are at variance with each other. For instance, he says: "Telegraph operating work is only, after all, a superior kind of typewriting."

This, on the face of it, is intended for a sneer, but I think telegraphists can afford to regard it as a compliment. A good typist must be a well-informed, smart, and fairly well-read and educated person. Those of us who are in the habit of

employing typists know that every type-writing operator does not unfortunately reach a high standard of excellence; but this only proves that skill and intelligence, with a good general education, are absolutely necessary in the ordinary typist. How much more then are such qualifications necessary in a "superior kind" of typist? Thus the remark can be disposed of without going into the merits of the case at all.

Again, Mr. Hanbury, evidently with the laudable desire of setting off one class of employé against another, says:—"I really believe that sorting requires more skill than the ordinary telegraphic work," while not three minutes later he says: "Sorting is, on the whole, much lighter work than telegraphic work."

How any man who professes, as Mr. Hanbury does, to know something of his subject, can say that the correct distribution of postal matter requires more skill than the translation of a telegraphic dispatch, and yet that the latter is the "heavier work," passes my comprehension.

Speaking personally, I know that my own general knowledge of almost every subject was gained through dealing with telegraph work at the Central Office, a knowledge I could never have acquired by reading the addresses on letters and postcards.

I do not wish to belittle the work of the sorters, but it does seem so absurd to say that their work requires more skill than that of the telegraphists.

With regard to the increase in the efficiency of telegraphists, I am, again, distinctly at variance with the Financial Secretary to the Treasury.

With the large increase in the press and general work, the gradual exclusive use of the wires for financial business, and the multiplicity of instruments employed, to say nothing of the technical knowledge which every clerk is encouraged by the prospect of a double rise to acquire, it is evident that the general efficiency of the average telegraphist must be very greatly in advance of that which obtained in the early seventies.

J. G. Purcell.

Candle power and Efficiency of Incandescent Bodies.

From experiments made with filaments composed of mixtures of various alkaline earths, I find that such filaments will burn in a vacuum. This is contrary to the statements made by Mr. Swinburne and others about the "Nernst" lamp. In fact, I find the same filament when giving the same candle-power, requires less energy than it does when burning in the open air, and, moreover, that the difficulties of the mounts when such filaments are in a vacuum almost vanish.

I think that the above facts are rather important, as I cannot imagine how it can now be said that the light of such filaments depends upon extra oxygen. This fact also, apart from other considerations, tends to show that such bodies are also not electrolytes, for it appears, that with the same filament, they require the same voltage whether they be run with alternating or continuous current, when either in a vacuum or in the open air.

A point of some interest that I have met with is, that such filaments, when run at the efficiencies given for the "Nernst" lamp, change so that the initial warming up temperature has to be gradually raised higher and higher, and I shall be glad to hear whether this point has been discovered and remedied in the "Nernst" lamp.

There are many other points which, with the few tests I have already made, show that the production of such lamps is surrounded with many practical difficulties, chiefly in obtaining uniformity of voltage, candle-power, and efficiency, and in obtaining good mounts; their increasing resistance and loss of candle-power whilst burning, &c.

Whilst dealing with the above subject, I may remark that I cannot understand how it comes that there are so many theories advanced for the efficiency, light, &c., of incandescent bodies generally.

It seems to be quite a simple matter. It is purely a question of temperature with the "Nernst" lamp, as with carbon or any other body raised to incandescence.

With a filament formed of alkaline earths, one possesses a body which is a bad heat radiator, consequently it does not require such a supply of calories per second to maintain it at any given temperature.

Again, with the alkaline earths, we have bodies whose fusing point is extremely high (much higher than carbon), consequently this temperature can be a much higher one than with bodies whose fusing points are lower.

In other words, a given quantity of such a body can be made to give a greater light, but at a greater temperature; this greater temperature, however, requiring less watts or calories for its maintenance owing to the body's bad radiating power.

In the face of this I do not see the necessity for speaking about the exchange of oxygen, electrolytic effects, &c.

C. J. Robertson,
Technical and Managing Director,
The Incandescent Electric Lamp Company, Limited,

Brook Green Works,
Hammersmith, W.

Electric Gong Buoys.

Permit me to submit a few remarks in reference to the criticisms contained in your valuable journal of February 17th on my proposed system of electric gong buoys.

With regard to the form of buoy best suited for the purpose in question, I would say that in considering this feature it appeared to me that the circumstances of each particular case would govern the decision as to the most desirable kind of buoy, and I therefore selected two types as affording the means of showing the main points in connection with the apparatus.

I would beg to point out that you are under a slight misapprehension in respect to the method of attaching the cable to the buoy.

In fig. 2 the cable is shown as being led up through a tube in the middle of the buoy; it is the bridle chain which is attached to the outside, so that battens—which you suggest—are unnecessary. This method of securing the cable to the buoy is an important feature, and one of the chief provisions mentioned in my paper is the thimble, by means of which the cable is attached to the heel of the buoy—see fig. 3, page 207, *Canadian Electrical News*.

The potency of your remarks concerning the difficulty of providing against the result of the violent action to which both buoy and moorings would be subjected, must be fully concurred in by all who have had experience in submarine cable work. This question of moorings is, to my mind, the crux of the whole problem. My endeavour has been not to prevent wear and tear, for that is impossible, but to minimise their effects, and it was with this steadfastly in view that my suggestion to lay the branch cables at right angles to the main line was advanced, for the purpose of rendering the examination and repair of the mooring cables possible without disturbing the trunk line.

The periodical inspection of every description of buoy moorings around our coasts is an operation in which several vessels are constantly engaged. No one would claim immunity from damage resulting from the action of the sea, for the electric gong buoys any more than one would expect the ordinary buoy moorings to remain intact, but it will, I think, be conceded that the operation of raising and repairing the electric cable would not be a difficult undertaking.

Where seaweed, kelp, &c., are present in large quantities, as they undoubtedly are in some localities, generally in the immediate vicinity of the shore, it is certainly a difficult matter to protect the cable, as we know full well from long and varied experience; but what I chiefly advocate is the providing of signals *broad off* the coast, and consequently in the majority of cases in comparatively deep water, so that no special provision is necessary as far as the shore end of the cable is concerned, beyond the ordinary treatment.

That a tight rounding of chain can be successfully applied to a cable is a fact, but I am not prepared to say that other methods of protection would not be preferable.

I most cordially agree with the suggestion with regard to the use of double and oppositely applied armouring; indeed, I may say that my original plans provided for this particular type of cable. It is a mistake to claim too much for any appliance, and it would be but reasonable to admit that there

are conditions under which it might be extremely difficult and even impossible to apply the system in question. This is obvious, and one need cite but one of the many failures in respect to shore ends landed in the wrong place.

I am pleased to find that the couplings have been tried, and whilst I have no desire to claim any special originality in respect to the particular form proposed in my paper, I may say that any mention of the T pieces alluded to had escaped my notice.

I will not trespass further on your space, beyond remarking that there should not be the slightest difficulty in maintaining the efficiency of an electric motor, placed in a waterproof chamber, which, being made to slip in and out over the central tube of the buoy, could be easily removed, together with the bell hammer, &c.

To effect this it would be only necessary to open the junction box immediately under the bell, disconnect the cable from its terminals, "come up" a key which secures the chamber hook on at eye provided for the purpose on bell yoke, and raise the chamber by means of the ship's bow line, or by a tackle and small derrick in the boat.

As you remark, "like many other ideas that have been formulated and put aside for a more favourable season, this has lain more or less dormant." It might have remained so for a while longer, but being asked to prepare a paper for the first Convention of the Maritime Electrical Association, I considered that the subject of electric gong signals, to which I had before called attention in the public press, would be an appropriate one, and I therefore took the matter up *de novo*.

One word more. There need not be an aperture for the rod connecting the lever with the bell hammer to pass through; all that is needed is a flexible diaphragm of waterproof material. I did not mention this detail, but it will readily be seen that the exclusion of moisture by means of such a device is a very simple matter. Perhaps the worst enemy, as far as the bell and hammer are concerned, is ice, but even this could be provided against.

As to mooring a buoy to a telegraph cable, even in the deepest water, there is not the slightest difficulty or danger, if due precautions are taken, but this is a question concerning which you appear to have very pronounced opinions, and as the discussion of the "axiom" would entail the lengthening of this communication beyond reasonable limits, I will merely add that with your permission I shall be happy to substantiate the assertion that a cable can be successfully buoyed "end up" in the deepest water.

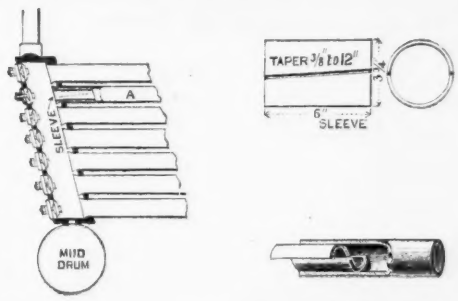
F. A. Hamilton.

Halifax, Nova Scotia.

NOTES.

Electroplating on Wood.—If a simple method of coating wood electrically with metallic deposits of silver or copper could be devised, there should be a considerable demand for such articles for ornamental parts of various articles of furniture, mouldings, picture frames, &c. Mr. C. F. Barnes describes, in the *Electrical World*, a method which, he believes, will meet the requirements. The operation is briefly as follows:—The wooden article is first saturated with copper sulphate by immersing it in a solution of that substance; then removed and thoroughly dried. It is then exposed to the action of hydrogen sulphide gas, which converts the sulphate of copper to the sulphide, which is a conductor of electricity, and also insoluble in aqueous solutions. Then the article is lightly wrapped with fine copper wire and suspended in a solution of common salt at the cathode, and a current of some density is passed. The copper sulphide is thereby speedily reduced to metallic copper by the reducing action of the cathode products. When the reduction is supposed to be completed, say, in 10 minutes, the article is transferred to an ordinary copper-plating bath, where a coating of copper of any desired thickness may be formed upon the surface. The copper surface may be polished or varnished, and is very adherent. For silver the process is modified by immersing the object, after preliminary coppering, in the silver-plating bath.—*Franklin Institute Journal.*

Ingenious Patch for a Leaky Tube.—An American street railway contemporary reprints from *Home Study* the following description of a method employed by Charles J. Mason, of Brooklyn, N.Y., to make tight a leaky boiler tube:—"The boiler was rated at 250 H.P., and carried a working pressure of about 90 lbs. per square inch. The leak was at the back end in a tube in the fifth row from the bottom, marked A in fig. 1. The tube was 4 inches in diameter, and the leak proved to be due to a hole about as large as a needle point near the sectional box in which the tube ends were



expanded. As it was not wished to condemn the tube for this small leak, a section 6 inches long was cut from an old tube and split in two lengthwise. The two pieces were bent slightly to conform to the curvature of the inside of the tube and the edges filed to a taper of ⅜ inch to the foot. After smearing the tube with a thick paste made of red lead and boiled linseed oil, the lower tapered piece was put in place and the upper one driven home with a hand hammer. The boiler proved tight when tested under 150 lbs. hydraulic pressure and has remained tight ever since."

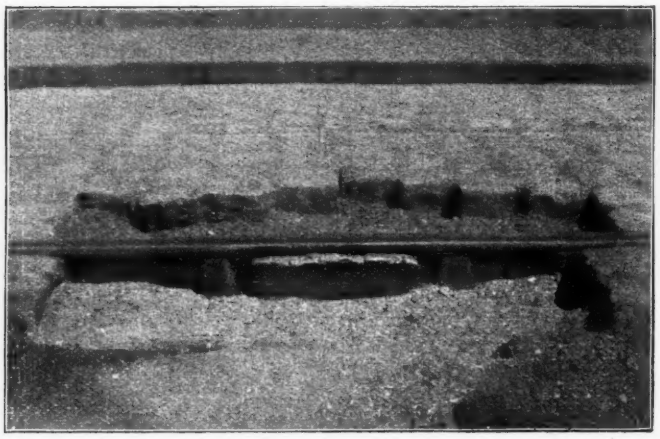
Projection Value of Various Illuminants.—In the course of one of his recent Society of Arts Cantor Lectures on "Acetylene," Prof. Vivian B. Lewes gave particulars of a method by which M. Molteni attempted to determine the projection value of various illuminants by a photometric process. The measurements were made with an ordinary lantern, the stage of which carried an opaque card in which was cut an aperture 0·7 cm. square, and the distance of the lantern from the screen was such that each side of the square on the screen measured 1 metre. The screen was replaced by a disc of paper, the opposite side being illuminated by a standard lamp burning 42 grams of oil per hour. The distance of this lamp was varied in order that equality of illumination might be obtained on the screen, and the photometric values of the light were determined from the distance of this lamp.

Multiplewick lamp	1·00
Incandescent gas No. 2 burner no reflector	1 00
Acetylene 1 burner no reflector...	1·06
" 2 " "	1 70
" 3 " "	3 20
" 4 " "	4·10
" 5 " "	4 50
Limelight, alcohol and oxygen	5·80
" oxyhydrogen	16 60
" etho-oxygen	18·50
Electric incandescent 32 candle-power...	0 68
" incandescent 50 candle-power vertical ...	0 93
" incandescent 50 candle-power horizontal ...	0·93
" focus 100 candle-power	3 82
" arc lamp 7 amperes	39 03
" " 10 "	75 61
" " 12 "	86 50
" " 15 "	117·61
" " 20 "	160 80

Across the Border.—Mr. Gay, electrical engineer at the Islington Vestry electricity works, writes:—"On page 385 of your current issue, 1,111, there is a paragraph headed 'Across the Border,' in which you state that the Islington Vestry has agreed to allow St. Pancras Vestry to take up the footways in Brecknock and York Roads, and lay electric mains along the same, although these thoroughfares are in the former parish. This, however, is incorrect, no such arrangement having been made, at any rate up to the present."

Shall there be Competition in the City?—On Monday, 27th inst., the Board of Trade, represented by Sir Courtenay Boyle, will hold a public inquiry at the Guildhall to consider the petitions of several electricity companies to be allowed to come in and compete with the City of London Company.

The Cast Weld Rail Joint.—We give an illustration



showing the Falk cast weld rail joint *in situ* on the Havre electric tramways.

The World's Telegraphs and Telephones.—The following is a statement of the approximate mileage of the telegraphic and telephonic systems of the world at January, 1899 :—

	Length in miles.			
	Telegraph lines.		Telephone lines of States and private companies.	Totals.
	of State administrations and private companies.	of railway companies.		
Lines				
1. Countries subject to the International Telegraphic Convention.				
European ...	490,200	179,570	169,300	839,070
Extra-European	167,500	64,620	14,290	246,410
2. Countries not subject to the Convention.				
North America—				
Western Union Co.	233,000	...	...	233,000
Postal Teleg. Co. ...	18,640	...	...	18,640
Other offices ...	...	248,500	186,400	434,900
America (South) ...	15,533	9,300	3,107	27,940
Africa, Asia, and Australia	24,853	27,960	9,320	62,133
3. Submarine Cable Companies ...	167,800	...	...	...
	1,117,526	529,950	382,417	2,029,893
Wire.				
1. Countries subject to the Convention.				
European ..	1,604,300	623,200	852,800	3,080,300
Extra-European	406,100	205,300	119,230	730,630
2. Countries not subject to the Convention.				
North America—				
Western Union Co.	1,003,400	...	...	1,003,400
Postal Teleg. Co. ...	108,730	...	...	108,730
Other offices ...	...	745,600	2,175,000	2,920,600
South America ...	29,820	27,960	31,070	88,850
Africa, Asia, and Australia	74,560	83,880	24,850	183,290
3. Submarine Cable Companies ...	169,600	...	...	169,600
	3,396,510	1,685,940	3,202,950	8,285,400

—*Journal Telegraphique.*

Dynamos for Electrolytic Work.—The generating plant at the electro-chemical factory at Mausbro, Dalecarlieu, Sweden, consists of eight horizontal turbines of 220 horse-power, coupled direct to six-pole dynamos. The dynamos are drum wound, and when running at 260 revolutions, give 115 volts, 1,200 amperes, at which load they have to run night and day without a break. As the least possible attendance was asked for, great attention was paid in designing the machines, so as to reduce the armature reaction to a minimum. This has been effected by making the magnetic field relatively very strong, dividing the pole pieces in a plane at right angles to the laminations of the armature, and employing the Sayer's commutating coils. The armature has 96 slots in its periphery, each containing two conductors (10 mm.), and a Sayer's coil (7 mm.). This last is of smaller cross-section, as it is only in circuit for a fraction of a revolution. The holes for the wires are slotted through to the periphery, thus decreasing the self-induction, and enabling the winding and insulating to be more easily effected. The efficiency at full load is 95 per cent., and the total weight of each machine is just under 13 tons. The work was carried out by the Allegemeinen Schwidischen Elektricitäts Gesellchaft, of Westeras. Sayer's winding has also been employed on the dynamos for the St. Helens Electro-Chemical Company, Limited, recently supplied by P. R. Jackson & Co., of Salford. The machines are eight in number, and each gives 180 volts, 1,500 amperes when running at 400 revolutions per minute. The field magnets are of cast-steel (Manchester type), and the armature is drum wound, with copper strip end connections. The core, 36 inches diameter, and 34 inches long, is carried on an 8-inch spindle. Of the total copper conductors, end connections and Sayer's commutating bars, built on to the armature, the Sayer's coils account for about 22 per cent. of the total.

Testing Arc Lamp Carbons.—M. P. Janet, director of the Laboratoire Central d'Electricité, Paris, recently delivered a Test Certificate to Mr. Fabius Henrion, of Nancy, as follows :—

The carbons bore the mark ‡ ‡

Five pairs of carbons, each consisting of a homogeneous carbon about 12 mm. in diameter, and a cored carbon about 17 mm. in diameter, have been tried from the point of view of resistivity.

The results obtained are given in the following table, which gives the resistivities in ohm-centimetres :—

Homogeneous carbons of 12 mm.	Cored carbons of 17 mm.
·00696	·00790
·00695	·00801
·00726	·00789
·00695	·00811
·00736	·00821

The hourly consumption of these carbons on a Pilsen arc using a continuous current of 10 amperes at about 43 volts, was found to be equal to 15·5 for the positive cored carbon 17 mm. in diameter, and to 12·3 mm. for the homogeneous negative carbon 12 mm. in diameter.

The weight of ashes collected was ·52 grammes for a consumption of 48 grammes of the two carbons.

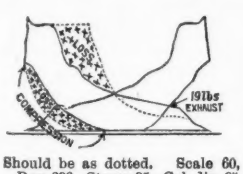
The Percentage of Certain Cells.—William Jaeger and K. Kahle have carried out a comparison of a series of Clark standard cells with cells of the Weston type during a period of over 12 months, in order to test the constancy of these cells. The mean of the results obtained is given below :—

Date.	Clark 0°, Cadm. 20°.	Clark 15°. Cadm. 20°.	Clark 0°. —Clark 15°.
March, 1896	1·4227	1·4066	0·0164 Int. volt
January, 1897	1·42277	1·40676	0·01631 "
November, 1897 ...	1·4228	1·40660	0·01650 "
Mean	1·42277	1·40663	0·01642

There is a long paper on this subject in the *Ann. Phys. Chem.*, 1898 (II.), 65, 926—942.

Insulation Rules.—With reference to the rules of the American Underwriters' National Electric Association, we note that it is permissible by these rules to use a quality of rubber inferior to that generally used by English cable manufacturers, as the insulation specified is somewhat lower than that usually specified on this side of the water, and, except for the smallest size, the thickness of dielectric given in these underwriters' rules is greater than the thickness specified on some English lists. We cannot think this is a step in the right direction, as we believe quality and consequent lasting power is the first consideration, and if a good quality is used a lesser thickness may be employed with better results. At one time it was considered in the States that an uniform thickness should be specified for any given voltage, independent of the size and consequent rigidity of the conductor; this was, of course, a mistake, and it is interesting to note that such a course has been abandoned. In our view, the rule of the Institution of Electrical Engineers is preferable to this American rule, since the thickness of dielectric in this in mils does not vary by leaps and bounds, but is steadily progressive $\frac{d}{10} + 31 =$ thickness in mils. We have received a list which in common with the lists of all leading manufacturers gives a thickness of dielectric corresponding to the rule of the Institution; if this is carried out in practice the result should be good where the employment of small conductors is avoided. Although the American plan of using solid wires in all cases tends, of course, to cheapen the core, we think it preferable not to use large solid wires, but for anything bigger than No. 12 S.W.G. a strand should be employed. Nothing is said in the American rules as to how insulation test should be assured; here we think the manufacturers lead by giving a certificate with all coils, although, as Prof. Ayrton points out, this does not necessarily prove the cable or wire is all right, and that independent check tests are necessary. Evidently our American cousins prefer that a more practical test, *i.e.*, a high voltage test be adopted, and do not desire to raise the question of insulation resistance too much, contenting themselves with a certificate of "Maximum voltage at which the wire is intended to be used." If these rules are widely adopted in the States, it will, of course, mean that English wires of standard size cannot be used there, but that American standard wires *may* be used here.

An Engineering Criticism.—The annexed illustration from the *Electrical Engineer*, of New York, represents the indicator cards from the engine at an American hotel, together with an ideal diagram from a text-book. They accompanied a criticism by one of the directorate, who had an opinion of his own abilities in steam engineering. The following is the critique, which is sufficient to illustrate the sort of thing engineers have to contend with—not always, be it said, in America only. The critic evidently confuses mean and initial pressure, and is singularly dense in respect



Should be as dotted. Scale 60, Rev. 290, Steam 95, Cyl. dia. 8", Stroke 10", M.P. 28 lbs, H.P. 24·5.

FIG. 1.

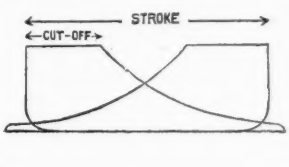


FIG. 2.

of the effect of speed upon power. "Your cut-off is about $\frac{1}{3}$; it should be $\frac{1}{4}$. Your exhaust is too early (due to high pressure), by which you lose 19 lbs. of steam, unless part of it is used for heating; even then it is not the best economy. It should be about 6 lbs. of steam lost at exhaust. Due to cut-off and exhaust, compression loses too much work. Revolutions should be about 320 per minute. Engines too large for work they are doing. Mean pressure is too high. Bring it down to 65 lbs.; that will lengthen the cut-off, and give more economical results, and a better card should be shown."

(*Continued on page* 426.)

BUSINESS NOTICES, &c.

Electrical Wares Exported.

WEEK ENDING JAN. 18TH, 1898.

Port.	Value.
Aden	£48
Alexandria	40
Amsterdam	200
Antwerp	195
Auckland	150
Bangkok	150
Bombay	21
Bremmerhaven	34
Buenos Ayres	75
Bushire. Teleg. mat.	140
Calcutta	102
Cape Town	125
Colombo	41
Flushing	160
Genoa. Old Teleg. wire	60
Gibraltar	15
Hamburg	35
Madras	99
Malaga	494
Melbourne	87
Monte Video	69
Natal	429
Odessa	63
Ostend	78
Port Chalmers	84
Port Elizabeth	45
Singapore	24
Sydney	60
Yokohama	107
Total	£3,103

WEEK ENDING JAN. 17TH, 1899.

Port.	Value.
Adelaide	£44
Amsterdam	30
Barcelona	33
Bombay	510
Boulogne	76
Bremen	50
Brisbane	15
Calcutta	763
Cape Town	563
Christiania	360
Colombo	27
Copenhagen	17
Delagoa Bay	28
Durban	669
East London	337
Gibraltar	23
Hamburg	110
Helsingfors. Teleg. wires	357
Hiogo	12
Malta	40
Rangoon	31
Rio de Janeiro	80
Santander	11
Singapore	907
Total	£5,033

WEEK ENDING JAN. 25TH, 1898.

Port.	Value.
Adelaide	£178
Alexandria. Teleg. wire	23
Amsterdam	60
Bangkok	24
Bombay	6
" Teleg. mat.	47
Boulogne	57
Calcutta	44
Cape Town	241
Colombo	9
Copenhagen	24
Durban	58
East London	10
Flushing	10
Genoa	297
Gothenburg	560
Hobart	15
Malta	48
Melbourne	72
Ostend	10
Port Elizabeth	236
Rangoon	22
Rosario	114
Shanghai	168
Singapore	32
Sydney	1 017
Vigo. Teleg. cable	10,920
Total	£14,267

WEEK ENDING JAN. 24TH, 1899.

Port.	Value.
Alexandria. Electric fuses	£55
Amsterdam	125
Auckland	223
Calcutta	1,698
Cape Town	815
Christiania	100
Colombo	69
Copenhagen	14
Delagoa Bay	10
Durban	98
East London	1,268
Flushing	11
Gothenburg	100
Hamburg. Teleg. mat.	110
Lyttleton (N.Z.)	32
Melbourne	145
Montreal	11
Ostend	5
Port Elizabeth	1,416
Reval	66
Shanghai	81
Sydney	81
Wellington (N.Z.)	740
Total	£7,303

Alternating Current Arc Lamp.—We have received from Mr. Fabius Henrion, of Nancy (France), particulars of the lamp he is now putting on the market for alternating currents. The feed is managed by means of a species of brushless motor. A disc, *d*,

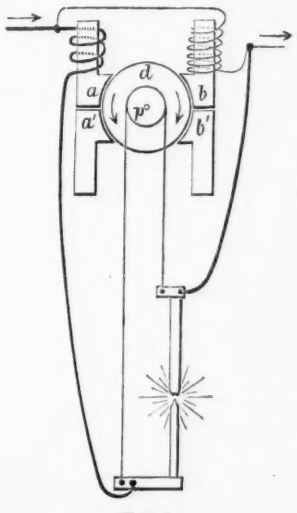


FIG. 1.

bearing a pulley, *p*, on its axis is worked so as to revolve freely between the poles of two electro-magnets, *a*, *a'*, *b*, *b'*, of which one is excited in series, the other by a shunt. A cord running over the pulley connects the carbon holders, and the revolution of the disc shortens or

lengthens the distance between the carbons. It will be evident that the slightest variation in the length of the arc is sufficient, with an alternate current, to cause the disc to revolve in either direction, and so maintain a regular feed. As long as the shunt and series currents balance the disc remains at rest, but a variation of $\frac{1}{10}$th volt will suffice to revolve the disc. In practice the disc is almost constantly in motion. The lamp is constructed to run:—Singly, at 33 volts; two in series, at 72 volts; three in series, at 105 volts; and

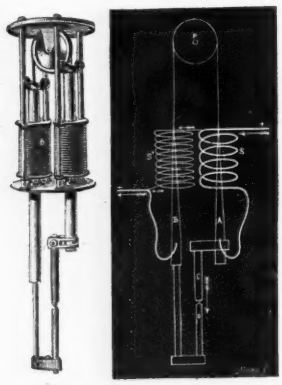


Fig. 2.

is made in two sizes: 6 to 10 hours and 8 to 16 hours with one pair of carbons. The absence of mechanism is a noticeable feature. The illustration to show the action of the lamp shows practically all the internal mechanism. Mr. Henrion is also putting on the market an improved form of Pilsen lamp, fig. 2, in which the mechanism has been reduced to the minimum, consisting simply of two solenoids and two cores connected directly to the carbons, doing away with rackwork gearing or brakes.

Beacon High Resistance Wire.—A slip occurred in our reference last week to wires "covered with this material." The Beacon resistance material is, we understand, made into wire solid, and is not covered, that is to say, the wire in strip, or whatever the makers may supply it in, is of the same composition through and through, and has not a covering only of the material.

Books Received.—"The Internal Wiring of Buildings," by H. M. Leaf, A.M.I.C.E., M.I.M.E. Published by Archibald Constable & Co., London. 3s. 6d.

"The Entropy Diagram and its Applications," by J. Boulvin. Published by E. & F. N Spon, London. 5s.

Catalogues and Lists.—Messrs. Williamson & Joseph, Ltd., have issued a new edition of their illustrated catalogue and price list (80 pages). The first few pages are taken up with photographs of the various departments at the Canonbury Works, along with a reprint of the description which recently appeared in the Electrical Review. The book contains numerous illustrations, description and prices of main and distributing switchboards, fuseboards, various kinds of switches, cut-outs, lampholders, and other electric lighting accessories.

Messrs. E. Duckenfield & Son, of Northampton, send us a list of their little dainty lamp shades, also their adaptable shade carrier for all sizes of incandescent electric lamp shades, and a new ornamental device for covering and attaching to electric lampholders.

Mr. Leonard Dakin, of Kentish Town, sends us a supplementary catalogue of electric light fittings showing illustrations of a variety of pendants, brackets, standards, electroliers, &c.

Messrs. Conrad, Knap & Co., Ltd., of Queen Victoria Street, are sending out a list of Knap's water-tube steam boiler.

Messrs. W. E. Rendle & Co., of Victoria Street, S.W., are issuing a list of their "Invincible" system of glazing for electric light stations, railway stations and similar structures.

The Chloride Electrical Storage Syndicate have issued a further section of their accumulator catalogue, this being devoted to renewals (K R and K L R types) and sundry items, such as insulators, acid pumps, hydrometers, battery inspection lamp. At the end of the list are sheets arranged for the user to fill in charge and discharge data of the cells while using. We are informed that there is a great demand for chloride plates to replace other types, and this has made a special catalogue necessary for this class of work.

From Mr. Severin Senator, of Berlin, we have received lists of his heating, cooking, and telephone appliances, also his current saving incandescent lamps (which are said to consume only 2·5 to 2·6 watts per C.P.-hour).

The Unbreakable Pulley and Mill Gearing Company, Limited, have issued a new price list illustrating their equal pressure friction clutch by general and diagrammatic views.

A small list has been received of the Crowdus accumulator.

The Sunbeam Lamp Company have just brought out a new catalogue, well printed and illustrated, in which they describe their various types and shapes of incandescent lamps, also terminals, lampholders, and sundry special lines.

Messrs. G. M. Callender & Co., of Westminster, are circulating a fully illustrated list of their pure bitumen damp course. A large number of photographs are shown of buildings where this material has been used throughout.

Messrs. Holden & Brooke, Limited, of West Gorton, have issued an abridged catalogue (January, 1899) of steam users' specialities in which they describe the Sirius self-acting, and Giffard's injectors, the exhaust steam injector, steam dryers, &c.

We have received from Messrs. Richard Melhuish, Sons & Co., of Fetter Lane, E.C., a copy of the latest edition of the engineers' section of their catalogue. The book contains over 300 pages of illustrations and descriptive matter of this firm's various manufactures of engineers' tools. The list has been revised up to date, and contains a very large selection of the latest patterns in stocks and dies, cutters, general machine shop and special precision tools, lathes, drilling and milling machines, and a variety of other apparatus and supplies incidental to all grades of engineering, and for contractors.

Change of Address.—Messrs. Lacey, Clirehugh and Sillar have removed to 2, Queen Anne's Gate, Westminster, S.W.

City Office.—Messrs. Gillies & Hornidge, electricians, of Haggerston and Buckingham, have taken City offices at Albert Buildings, 49, Queen Victoria Street, E.C.

Correction.—With reference to a statement in our issue of March 3rd, to the effect that Messrs. Prestwich & Burt, are to fit up the new Institute at Kingston-on-Thames, the firm write to point out that they are *not* successors to Messrs. New & Mayne. The fitting up of the Institute was completed some little time ago.

The Davy Improved Arc Lamp.—The enclosed arc lamp hitherto associated with the name of Mr. W. Davy, and at present manufactured by the Davy Electric Construction Company, Limited, has met with general favour, and its merits have been appreciated. Mr. Davy himself, however, severed his connection with the company some months since, and has been employing his time in an effort to produce a form of lamp which should be free from the objectionable features hitherto found associated with both the open and enclosed types of lamp. As the result he is about to introduce what will be known as the Davy improved arc lamp. He claims to have perfected the method of sealing, and to have reduced the operation of trimming to the utmost simplicity. A carbon holder of ingenious design obviates the trouble arising from a carbon breaking off short and having to be drilled out. The lamp is only about 2 feet in length, and weighs not more than 12 lbs. These are novelties in design that combine to render the lamp specially suitable for interior and domestic lighting. Being exceedingly simple in construction, it can be produced at a low cost, and will probably be offered to the public at a "record" price.

An Electrical Advertising Sign.—An electrical advertising sign which has just been fitted up at Oxford Street and corner of Tottenham Court Road, is an entirely new arrangement, designed and patented by Mr. W. T. Bell, of Nottingham. This patent has been acquired by the Universal Electrical Advertising Syndicate, Limited, of that city, under whose instructions the sign mentioned has been erected. Arrangements are in progress for the putting up of similar machines in other large towns, not only in this country, but also in France and the United States, for which countries patents have already been obtained. The sign consists of two sections, one below the other, each containing 504 lamps, so that the total number of lamps employed exceeds 1,000 (although the total number in use for any one display rarely exceeds 300). It is possible to exhibit almost any number of advertisements successively, each being timed to appear for about 10 seconds, followed by three seconds of darkness. An ingenious arrangement is introduced by which the lamps in each row light successively from the bottom upwards, producing the effect of a blind being drawn rapidly up, and exhibiting the particular wording desired. The first sign of this kind was erected some time ago at Nottingham, but the one now erected as above is a distinct improvement on the original. The work, both as regards the construction of the electrical machinery, the controlling mechanism, and the outside sign has been carried out by Messrs. Laing, Wharton & Down, Limited, at their London works, where they are now engaged on similar machines for erection in other centres. The great advantage claimed for this invention is that almost any advertisement or announcement may be made to appear at pleasure without any alteration in the structure of the sign. The interior apparatus is of a compact kind, and is entirely automatic and worked by an electric motor.

Fire.—On 7th inst. a fire occurred at the works of W. T. Henley's Telegraph Works Company, Stanley Road, North Woolwich, through resin boiling over. The damage done was very trifling, and will not in any way interfere with the company's business.

The Glasgow 1901 Exhibition.—With a view to holding "one of the most important international exhibitions in Great Britain in recent years," the Glasgow International Exhibition of 1901 is being arranged. The executive is already getting to work circulating prospectuses, and this fact alone is sufficient to indicate the important scale upon which the affair is being planned. H.M. the Queen has lent her name as patron, and the Prince of Wales is a vice-patron. The town clerk of Glasgow, Sir James Marwick, is hon. secretary, Mr. H. A. Hedley being general manager. The Glasgow Corporation has granted a site of 67 acres at Kelvingrove Park. So far as the scope of the exhibition is concerned, it is intended for it to present a full illustration of the produce and manufactures of the British Empire and all its colonies, &c. In regard to classification of exhibits, Class III. will be devoted to machinery, motive power, electricity, and labour-saving appliances in motion; Class IV., locomotion and transport; Class VI., lighting and heating; Class VII., science and scientific instruments, &c. All communications should be addressed to Mr. Hedley, at 36, St. Vincent Place, Glasgow. It is the wish of the Glasgow Corporation to have all the city tramlines equipped with electric traction by the time of the opening.

The Hyatt Roller Bearing.—Those interested in roller bearings would do well to study the Hyatt system. In this system the rollers are not solid bars, but are elastic spirally wound tubes. They have thus considerable flexibility, and they are designed to obviate that unequal distribution of pressure which is thought by some to be an objectionable feature of solid rollers. Many causes may produce such unequal bearing pressure. The *Journal of the Franklin Institute*, which illustrates and describes this bearing, says that the pressure capable of being carried by a roller depends upon its hardness and that of its supporting bearing, and upon its velocity, and in a series of tests with four solid ¾-in. rollers of 70,000 lbs. tenacity steel, and four Hyatt rollers formed of steel strip ½-in. by ¼-in. rolled between flat plates under pressures up to 550 lbs. per linear inch of the rollers, which were all 10 inches long, the resistance to motion to and fro was, with a total of 2,000 lbs. pressure, 9 lbs. with the flexibles and 26 lbs. with the solid rollers. With 3,000 lbs. the resistance was respectively 17 and 34 lbs. While 550 lbs. per linear inch was the maximum load the apparatus would bear with solid rollers, as much as 700 could be applied with Hyatt rollers. An average of 51 per cent reduction for resistance was obtained with the new rollers on smooth plates, and 23 per cent. less when one plate was rough. The bearing of the spirally wound rollers was more complete, especially with the rough plates, and there was less wear. In other respects the Hyatt roller is carried in the same cage as ordinary rollers and requires no special treatment. Though not named it would appear as though the slight gap at the spirals of the winding might serve a useful purpose as an outlet for any accidentally introduced grit or dirt and contribute to easy working.

Local Authorities and Electric Lighting.—In the House of Commons on Friday last Mr. Ritchie, replying to Mr. Thomas Bayley, said there were 30 local authorities who had obtained provisional orders for electric lighting who had taken no steps to give effect to their orders within the time prescribed for the execution of compulsory works. Besides these there were 63 other local authorities who obtained orders in 1897 and 1898, and had apparently done no work, but the time prescribed by their orders had not yet expired. The Board of Trade had lately intimated to local authorities who were not exercising their powers that the Board proposed to consider the question of revoking the orders. In nearly all these cases the local authorities had replied that they were now taking steps to carry their orders into execution.

London County Council.—At last week's meeting the Council resolved to sanction a loan of £38,750 to the Islington Vestry for electric lighting works.

The Earl of Onslow asked when the inquiry would be held by the Light Railway Commissioners in reference to the application for powers to construct light electric railways at Finchley, Hendon, and other districts.

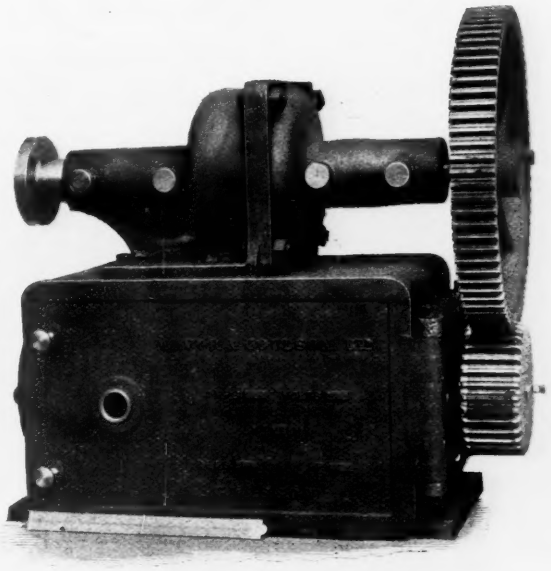
It was reported that the Middlesex County Council had resolved to avail itself of the provisions of the Light Railways Act, and to promote such light railways within the county as circumstances may from time to time require. The L.C.C. Parliamentary Committee had passed on the Middlesex resolution to the Highways Committee with a view to concerted action being taken by the London and Middlesex County Councils in the construction of light railways.

The Highways Committee brought up several recommendations on the telephone question. They thought that the telephone service in the London area of the National Telephone Company should be managed by the Council, the Corporation of the City of London, and the local authorities of districts, and advised that application be made to the Postmaster-General for a license. Mr. Westacott moved that the report be referred back for further consideration, in view of what had taken place in the House of Commons. Mr. Beachcroft seconded that amendment and said that Mr. Hanbury's announcement was a disappointment to some of them. Mr. J. W. Benn, chairman of the Highways Committee, said that the recommendations would merely strengthen the proposals of Mr. Hanbury in regard to London, and would show to the Post Office that the Council were prepared to provide a telephone system for the metropolis. If the Council declined to proceed in the matter their friends in the City would charge them with backing out of a useful partnership. Mr. Westacott withdrew his amendment in favour of the report being postponed for a fortnight, and this was agreed to.

The Council on Tuesday this week decided to lend £2,851 to the Battersea Vestry for the purchase of land for the extension of the electric lighting station.

The Highways Committee submitted the following report on the subject of light railways:—"We have under consideration the question of what extensions of the Council's tramways systems on both sides of the river are desirable and expedient; and in connection with this matter we have come to the conclusion that it would be of advantage if the Council were to make use of some of the provisions of the Light Railways Act in order to develop the tramway system in the suburban areas around London, and that the Council should endeavour to enter into arrangements with the County Councils of those districts with a view to joint action being taken which may result in the construction of an extensive system of locomotion. We have little doubt that if such arrangements could be come to, they would not only materially increase the earning capacity of the Council's tramways, but be of great benefit to the adjoining districts by affording easy and cheap means of transit to and from the central parts of London." It was resolved to authorise the Committee to prepare and submit schemes and to enter into negotiations with the other authorities with a view to combined action being taken in the direction indicated.

Motor Reducing Gear.—We illustrate herewith an electric motor combined with Messrs. Mavor & Coulson's Ross' reducing gear. The reduction provided for by the arrangement shown is 70 to 1. The motor is entirely enclosed, the shell being of cast-steel, and the side doors which open the whole length of the motor on both sides are of cast-iron. The motor pinion is raw hide shrouded with



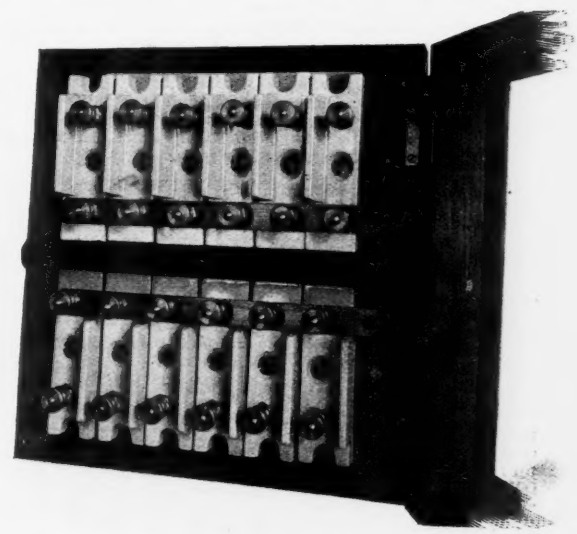
gun-metal, and the spur wheel is of cast-iron, machine cut. With the same arrangement greater reductions can be obtained, even to 200 to 1. For large reduction the gear is claimed to be most compact and efficient.

Nernst Electric Lamps in Berlin.—It is reported that the Allgemeine Electrici äts Gesellschaft, of Berlin, is in negotiation with the Berlin municipal authorities with reference to an experimental trial of several Nernst lamps in the Thiergarten.

New Branches.—Increased business has led the Electrical Company, Limited, to establish (in addition to their branch at Brighton, for the South Coast), a branch in Manchester at 21, Corn Exchange Buildings, Fennel Street, for the convenience of customers in Lancashire, Yorkshire, Nottinghamshire, Staffordshire, Cheshire, and Derbyshire. Mr. A. Ward, who has been long in the company's service, has been appointed manager. The Electrical Company has at present on order machines aggregating nearly 2,000 H.P., and the monthly sale of their celebrated "Luna" arc lamps, enclosed and open types, reaches nearly 400.

Messrs. Handley & Shanks, of London, Dublin, &c., have opened a branch at 46 and 47, Corn Exchange Buildings, Fennel Street, Manchester. Mr. C. E. Hunter will represent the firm there.

New Distribution Board.—We illustrate below a new distribution board, which is the design of Messrs. A. E. Bennett and



Co., and is being made by Messrs. Burbey & Hutton. It is made up of separate porcelain slabs, one for each single pole, each slab being provided with a bridge-piece on one side, so that the right-hand

bridge of one makes the left-hand bridge of the next, and so on. Each slab has one screw in its centre, and with this and the bus bar it becomes as one piece. All the connections, with the exception of the main, are made on the front by hexagonal nuts. The fuses are fixed by thumb screws direct on the same terminal, thus obtaining the best possible mechanical contact. It is claimed that a board of any number of ways can be made up at very short notice, and if one slab is broken it can be replaced at a very moderate cost. No fuse can splash its neighbour. The slabs are so designed that the manufacturer can make up a 5, 10, or 15-ampere way-board. The boards are fitted up in teak frames.

New Works.—Large new works are approaching completion at Southfields, Wandsworth, S.W., for the Berrenburg Electric Lamp Syndicate, Limited.

Notices re Liquidations, Dissolutions, &c.—Globe Electrical Advertising Company, meeting at 1, St. Peter's Church Walk, Nottingham, April 13th, to hear liquidator's (Mr. T. C. Leman) report of winding up.

Messrs. E. I. Everett and W. J. Cole (Everett & Co., engineers and electricians, 22, Charterhouse Square, E.C.) have dissolved partnership. Mr. Everett will attend to debts, &c.

Messrs. F. F. Bennett and W. H. Walley (Bennett & Walley, electrical engineers, Deansgate, Manchester) have dissolved partnership. Mr. Bennett will attend to debts.

Messrs. W. H. Booth and J. G. Dunn (Dunn & Booth, engineers, 52, Peartree Street, Goswell Road, London) have dissolved partnership from February 2nd.

The first meeting of creditors is arranged for March 21st, and the public examination for April 7th, at Leicester, in the failure of F. Marson (F. Marson & Co., electricians and ironmongers, Leicester).

Application is to be made for debtor's discharge in the case of P. C. Pope, electrical engineer, Hapton, near Derby, at the Court House, Burnley, on May 20th.

Messrs. J. R. Craig and F. J. Woodward (Woodward & Craig, electric light and power engineers, 69, Waterloo Street, Glasgow) have dissolved partnership. Mr. Craig will attend to debts.

Presentation.—Mr. E. H. Johnson (of Messrs. Donnison, Barber & Co., Manchester), has been presented with a handsomely illuminated testimonial by the executive of the Wigan Arts and Crafts Exhibition, for "professional services rendered in connection with the electric light and power plant, during the run thereof."

Receiving Orders.—A receiving order was made on March 3rd, on the creditor's petition, in the case of Noah Mitchell, electrical belt maker, 194, Regent Street, London.

A similar order was made, on debtor's own petition, on March 6th, in the case of Frederick Marson (F. Marson & Co.), electrician and ironmonger, Poplar Avenue, King Richard's Road, Leicester.

The Regenerative Boiler Furnace Company.—*Apropos* of the report of the Paris Smoke Commission and their conclusion that smoke prevention was costly, we have received a protest from the Regenerative Boiler Furnace Company, denying that smoke prevention is costly. From the pamphlet that is sent us by them we note that the furnace they employ is arranged to admit air, forced by a fan, in fine jets by means of small pipes of highly refractory material into the centre of a volume of the hot furnace gases, with sufficient force to cause admixture and promote thorough combustion. The object sought is the use of as small an excess of air as possible. Air is introduced through a pipe laid along the ashpit, and communicating with an air box laid behind the bridge. From this box rise up a series of narrow refractory chambers pierced laterally with holes for the outlet of the air. The fine jets of air are thus directed transversely into the streams of passing gas and the device appears calculated to effect its object. Figures are given from a report of Messrs. Barstall and Monkhouse, from which good results appear to have been obtained from bituminous North country coal, both alone and mixed with green oil, we suppose to give coherence of dust. It certainly appears good practice where dust coal can be employed, to give it the desirable coherence by means of a combustible rather than by heat absorbing water. The oil itself is a magnificent fuel. We should be glad to receive a copy of the reports named in the pamphlet. The principle and construction of the furnace are sound, and we should anticipate that it would secure smokelessness.

Theatre Lighting.—Last week it was stated in this column that the Lyric Theatre was being fitted for electric lighting. As a matter of fact a complete plant was put in when the theatre was erected, and no work is now being carried out there. Our information came from a seemingly erratic correspondent.

The Ward Leonard Specialities.—The Ward Leonard Electric Company, of Bronxville, New York, report a very strong and rapid increase in business since the beginning of the year. The company's goods are used very largely abroad and many very handsome orders have been received by the company lately, a single order from a German manufacturer being for over 500 rheostats. The company state that they are selling large quantities of a very compact form of rheostat for small ventilating fan motors, in which the wires are enamelled upon the surface of a small pottery tube. This makes a very simple, compact, and permanent form of resistance, and the cost is surprisingly low. A motor-starting rheostat with automatic release, selling at 2s. per H.P., seems amazingly cheap, yet this is the figure which has been reached in this line of business. The company report that they now carry a complete line of Carpenter enamel field rheostats from 2 ohms to 1,000 ohms, and all of commercial sizes. Also all sizes of motor-starters, both with automatic release and without this feature, in all sizes from ¼ to 50 H.P., and for 125, 250, and 500-volt circuits; also all commercial sizes of theatre dimmers, ventilating fan controllers, and motor speed regulators. The company state that they have over 1,100 rheostats in stock, enabling them to fill any ordinary order the same day it is received. The company have recently introduced a new form of rheostat for instances where very high resistance is required. It is claimed that the cost of manufacture is a mere fraction of the cost of their former type for high resistances, which was already the cheapest on the market. The use of high resistances for the regulation of field currents of motors is rapidly on the increase, and the high cost of field rheostats for motors of 500 volts, or even 250 volts, has been quite a drawback to such methods, but it is claimed by the Ward Leonard Company that with their new form a rheostat of many thousand ohms can be made at the same cost as one of the same watt capacity of lower ohms. The new rheostat is based upon a recent invention of Mr. H. Ward Leonard.

Willing's Press Guide.—The issue of this handy "Press Guide" for the current year is now published (125, Strand, W.C.).

ELECTRIC LIGHTING NOTES.

Aberdeen.—Mr. J. A. Bell recently reported as to the progress made in the electric lighting department in the previous year, and the need for additional plant to meet the increased demands by private consumers and the supply for the trams. The estimated cost of this plant he stated at £7,500. The Council has now authorised him to invite tenders for the additional plant.

In consequence of the extension of the electric lighting system, an outdoor assistant to the electrical engineer is to be appointed.

Arbroath.—The Board of Trade had resolved not to allow the clause in the provisional order giving the Corporation power to hand over the electric lighting to a private company, to remain in the order. One or two companies are stated to intend to make a fight for the retention of the clause, and the Corporation will join them.

Bangor.—It is now stated that the signatories of the electric light bond have decided to withdraw the bond, by which they had agreed to guarantee the town against any loss on account of the introduction of the electric lighting scheme. It is said that the promoters of the scheme intend to promote a company to supply the town with electricity.

Barmouth.—The Council has received a communication from the Board of Trade touching the Council's objections to the projected electric lighting scheme of Mr. David Davies. The Council will sit in committee to discuss its reply.

Barnsley.—The Lighting Committee recommend that a clerk of the works be appointed for the electricity works at a salary, during the construction of the works, of £150 per annum, and after their completion of £200 per annum.

The Chairman of the Parks and Lighting Committee on 9th inst. laid the corner stone in connection with the electricity works.

Barrow.—It has been resolved that the borough electrical engineer shall confer with Mr. Manville in regard to the extension of the plant and buildings, in order to be ready for next winter's supply. Up to the present about 7,000 lamps have been applied for, and this nearly represents the capacity of the plant.

Batley.—On 9th inst. the Council appointed Messrs. Lacey, Clirehugh & Sillar, to advise them on a scheme of electric lighting and traction.

Battersea.—The Vestry last week considered a long report by the Lighting Committee dealing with a scheme for lighting the parish by electricity. It appeared from the report that Prof. Kennedy, the consulting engineer, and Mr. C. Stanley Peech, the architect, had attended before the committee on several occasions, and the committee now submitted the scheme as prepared by the consulting engineer. The scheme provides for the installing of plant capable of supplying 24,000 8-C.P. lamps, and 240 arc lamps, the method of supply to be the continuous current three-wire system, with 230-volt lamps. The cost is estimated at £102,000, being £42,000 for buildings, and £60,000 for plant, mains, and street lamps. After a short discussion the scheme was adopted, and the committee were authorised to carry it to a practical issue.

Belfast.—The engineer has been instructed to advertise for tenders for laying mains. The question of electrically lighting several of the principal thoroughfares has been held over, pending a report from the engineer. The tender of Messrs. Babcock & Wilcox for water-tube boilers has been accepted.

Brighton.—The statement of accounts of the Corporation electric lighting undertaking for the year ended December 31st, 1898, has been completed. The income amounted to £42,194 11s., and the expenditure to £22,846 14s. 7d., surplus, £19,347 16s. 5d. From this balance £147 16s. 5d. is deducted for bad debts, and £19,200 carried to net revenue account. Payment of interest on redeemable stock, loans, &c., absorbs £5,844 2s. 9d., and sinking fund, £6,553 16s. 8d., leaving a balance of £6,802 0s. 7d. The manager of the works (Mr. Wright) having reported that the storage batteries and meters are now of much less value than when purchased, the Lighting Committee have allocated the balance as follows:—Relief of general district rate, £2,135; depreciation of batteries, £2,000; depreciation of meters, £1,000; engineer's commission account, £1,496. The

above are round figures, the exact sum carried to engineer's commission being £1,496 17s. 9d. The remaining £170 2s. 10d. is added to the reserve fund, which will then amount to £7,107 14s. 3d. The income from sale of electricity was made up as follows:—820,985 units at 7d., £23,945 7s. 11d.; 1,277,811 units at 1½d., £7,986 6s. 3d.; 56,475 at 7d. (public lamps) £1,647 3s. 9d.; 493,430 at 1½d. (public lamps) £3,083 18s. 9d.—£36,662 16s. 8d. The difference between this and £42,194 11s. was made up by £3,437 7s. 9d. for attending to public lamps, £366 9s. 10d.; for installation works on public lamps, £947 14s. 1d.; for rental of meters, &c, £700 7s. 8d.; for work executed for customers; £58 17s. 4d. brought forward, and a few minor items. There are now 257 public arc lamps and 941 public incandescent lamps. The quantity of electricity generated was 3,242,017 units, the total sold 2,648,701 units, used on works, 158,193 units, not accounted for 435,118 units. During last year the expenditure on capital account was £25,652 12s. 8d., bringing the total capital expenditure to £237,987 3s. The amount authorised to be borrowed is £290,881, of which £67,725 19s. 10d. has not yet been taken advantage of. The Lighting Committee have resolved:—"That as from January 1st last the charge for electricity, after the first hour's consumption, be reduced from 1½d. to 1d. per unit."

Bristol.—The Electrical Committee proposes to purchase a warehouse on the east side of the electricity works for the purpose of extensions, and £2,500 is to be borrowed in addition to the £25,000 authorised last month.

Burton-on-Trent.—On 7th inst. an inquiry was held concerning the application of the Corporation to borrow £32,500 for purposes of sewage disposal and electric light extensions.

Campbeltown.—The electric light is about to be introduced in Machribanish. Captain Macneal is laying down the necessary plant for an installation of the electric light at Losset Park, and also for the newly completed hotel. Negotiations are being opened for an extension of the light to the villas at Pans.

Cardiff.—On Monday the Council discussed the question of taking proceedings against Messrs. Ferranti to recover £2,112 for the non-fulfilment of a contract. The upshot was the decision to take counsel's opinion as to the advisability of taking proceedings.

The Finance Committee on 2nd inst. dealt with the financial estimates for the coming half-year. In consequence of the reduced charges for electric light there was a debit balance of £480, whereas a profit was expected.

The Central Electric Supply Bill.—Last Friday the above Bill came before the Court of Referees at the House of Commons, the opposition of the Metropolitan Electric Supply Company and the Vestry of Paddington being objected to on the ground that they had no *locus standi*. The Court decided that the Metropolitan Electric Supply Company had only a *locus standi* limited to Clauses 26 and 27, relating to mains and wires, the *locus* of the Paddington Vestry being entirely disallowed.

Chatham.—Mr. Hewett has submitted plans to the Town Council for the lighting of the new Town Hall by electricity. The committee have recommended that the scheme be approved, and that tenders be invited for the wiring.

Coventry.—Residents in the vicinity of the electric light station, off the Foleshill Road, have sent in a memorial wherein complaint was made of the annoyance caused to them by the noise from the machinery. The Electric Light Committee is considering the matter. The Committee reports having come to the conclusion that under the system of charges for electric light adopted in 1895, the scale pressed unduly upon a certain class of consumers, and thereby restricted consumption. After inquiries, they had come to the conclusion that the full price of 6d. per unit should be charged only on a consumption equivalent to one hour's use per day instead of two, and that all further consumption should be charged at the rate of 3d. per unit. This course the Council has approved.

The demand for electric light continues to increase. The statement for the quarter ended December 31st gives the amount of current supplied as 45,423 units, as compared with 34,895 units in the corresponding quarter of 1897. The rentals produced £1,042 8s. 6d., as compared with £830 8s. 9d. There was an increase of 28 consumers.

Devonport.—The Electric Lighting Sub-Committee recommend the appointment of a residential engineer at a salary of £300 a year, and the retaining of Prof. Kennedy as consulting engineer.

Douglas (I.O.M.).—The Sanitary Committee has been inquiring *re* sites for electricity works, and will report shortly.

Dover.—The Council has given the Dover Electric Supply Company permission to extend their main in the pier district.

Downham.—The District Council last week had before it a note of the fees of two firms of consulting electrical engineers for drawing up an electric lighting scheme, but after discussion it was decided not to engage either firm. Various speakers expressed opinions favourable to the continuance of the present oil system, others advocating the purchase of the gas works.

Dublin.—Messrs. Handley & Shanks have secured the contract for an installation for the Richmond Lunatic Asylum. The work (costing £3,000) comprises the supply of two steam engines, dynamos, battery of accumulators, wiring, &c. Mr. Walter Leake is consulting engineer.

Edinburgh.—The Electric Lighting Committee recommends that the resident electrical engineer be allowed, as at present, so far as consistent with his regular duties, to perform work connected with the wiring of buildings for the Corporation, and charge the department therefor.

Fareham.—Last week the Finance Committee reported that the expenditure on the electric light works for the six months ending 31st ult. was £1,885, being £566 towards repayment of loans, £1,125 for maintenance, and £200 for an alteration, for which the loan was not sanctioned by the Local Government Board. The receipts from private consumers of electric current amounted to £800. Adding the expenditure and receipts in respect of electricity works, the total expenditure was £6,000 and the receipts £6,250. Mr. Sandy, chairman of the committee, pointed out that the Council had saved £200 in the last half-year, and they had received £75 additional for electricity. They estimated they had received £300 on the new assessments, and trusted that they would receive another £50 during the present half-year. They had reduced the cost of maintenance of the electric works by £75 through the new machinery, but the loans had gone up £240. They received £800 from private consumers, and, allowing £650 as the cost for public lighting, left a deficiency of a little over £400.

Glasgow.—The Corporation last Monday again considered the question of purchasing the undertaking of the Kelvinside Electricity Company. The Council had offered to pay £30,000, but the company has asked £37,000, and the Electricity Committee has advised that this sum be agreed to conditionally.

Gosport.—The District Council is to apply for a provisional order. A committee has considered the question of supply, together with a letter from the Electrical Power Distribution Company, and while the chairman of that committee is not prepared to recommend the Council to take upon itself the responsibilities of electric lighting, he considers it advisable to apply for the provisional order. Does this indicate a transference arrangement with the company mentioned, or a proposed dog in the manger policy?

Greece.—La Société Electrique de la Mediterranée (Thomson & Houston) has secured a 60 years' concession for the electric lighting of the town of Krania, Cephalonia.

Guildford.—Amongst other improvements being carried out at "The Angel" hotel, Guildford, is an electric light installation by Messrs. Bowden, Higlett & Co., of that town. This firm have recently completed the lighting of Holy Trinity Church, Guildford, with 68 16-C.P. frosted lamps. The supply in each case is derived from the supply company's mains.

Halifax.—The Board of Guardians has decided to have an electric lighting installation, at a cost of £1,000, for the workhouse.

Harwich.—The Town Council has unanimously resolved to accept the offer of the English Industrials, Limited, of Manchester, to purchase the powers under the 1892 Lighting Order. The company will pay the Corporation £300, and give an undertaking to immediately (or within one year from the date of the contract) instal the electric light in Harwich and Dovercourt throughout the compulsory area of supply.

Hawick.—The Corporation have agreed conditionally not to oppose an application proposed to be made for a provisional order relating to Hawick by an electric lighting company.

Hereford.—Plans and specifications have been completed for electricity works, and the Council has authorised the Electric Light Committee to advertise for an electrical engineer as clerk of works.

Hornsey.—(*Motto.*—"*I want to know if we are going to sell our birthright.*"—Henry Burt.) This important suburb of London is in possession of a provisional order under the provisions of which the District Council is under the obligation *at the beginning of next year* to "lay down on requisition suitable and sufficient distributing mains for the purpose of general supply." It is also under the obligation whether requisitioned or not to be in a position to give a general supply of electrical energy in certain scheduled streets *by the middle of next year*. The order also contains the usual section empowering the Board of Trade "at any time after the commencement of the order to revoke the order if they have reason to believe that the Council have made default in executing works, &c." The action of the Council with regard to the order is being anxiously watched by certain companies, more than one of which appears to be desirous of securing so profitable a district as Hornsey undoubtedly presents, including as it does the bulk of Highgate, Hornsey Lane, Crouch End, &c. So far, the Council have played into the hands of the companies by not stirring one step in the direction of laying down works, and the hope of the companies is that the Council out of sheer ignorance of the present temper of the Board of Trade may go muddling on and find its powers revoked. That revocation is in the air, is made certain by the terms of the reply of the President of the Board of Trade to Mr. Thomas Bayley on Friday night in reference to the 30 local authorities who had taken no steps to give effect to their orders within the time prescribed for the execution of compulsory works. Mr. Thomas Bayley, be it observed, was one of the promoters of the General Power Distributing Bill, and, smarting under the defeat of that measure, he is determined that local authorities shall no longer be permitted to play the "Dog in the Manger" game in electric lighting matters. From our seat in the Gallery of the House of Commons on Friday we noticed that he was drawing Mr. Bromley Davenport's attention to a newspaper. We wonder whether it hap-

pened to be the *North Middlesex Chronicle*, in which Mr. C. F. Cory Wright, J P., the chairman of the Hornsey District Council, proceeded as follows to destroy the confidence of the Board of Trade in the Council's *bonâ fides* in their application for Parliamentary powers:—

The Chairman: When the question of the provisional order was first brought up it went to a special committee, and it was understood the Council was not pledged to go on. They had three years and could get the order renewed.

Mr. Burt: Two.

The Chairman: Three. He went on to say they could get it renewed, and it was got to keep other people out. They thought then it was better to do it themselves if at all. Since then all matters have gone to the Lighting Committee. If they were dissatisfied it might be taken out of the hands of the committee.

Mr. Burt was not complaining of the committee, but of it being shelved. It ought not to be hung up for ever.

Here we have a public statement from the chairman of an important District Council, possibly a mayor in embryo, to the effect:—1. That the application to the Board of Trade was a bogus one, "not pledging the Council to carry out the work." 2. That they could go on hoodwinking the Board of Trade *ad lib.* 3 That the real object was "to keep other people out." 4. That though they had once "thought it was better to do it themselves *if at all*," they were fulfilling their duty to the Board of Trade and to their constituents by shelving "all matters connected therewith." Now that the chairman has so declared himself, the enterprising tradesmen of Crouch End, who want to be put in the same position as their competitors in the neighbouring parish of Islington, will doubtless combine to relieve those gentlemen who uphold this reactionary policy of their seats on the Council.

Inverness.—At a meeting of the Inverness District Lunacy Board, held on the 3rd of this month, it was agreed to adopt the proposals of Dr. J. T. Bottomley, F.R.S., for the lighting of the asylum by electricity at a cost not to exceed £5,000. Tenders for various items connected with the work were presented and discussed, and those for engines (Tangyes, Birmingham), dynamos (Siemens), and switchboard (James White, Glasgow) were accepted.

Karachi (India).—The managing committee of the municipality have resolved on giving Messrs. Macdonald & Co. an undertaking for two years not to entertain any other negotiations for municipal lighting in consideration of their bringing out an expert to report on the feasibility of introducing electric lighting in Karachi, and placing such report at the disposal of the municipality.

Leatherhead.—The District Council, sitting in committee, has, by the casting vote of the chairman, decided upon the adoption of the electric lighting scheme drawn up by Messrs. Handcock & Dykes.

Leeds.—The City Council last week resolved to borrow £150,000 for electric lighting purposes Alderman Wigram said that the completion of the present station had cost £33,500; the Committee had spent £46,000 on increasing the mains and sub-stations for distribution; and £12,500 had been set aside to provide capital expenditure, making a total of £92,000. The increased output for this expenditure was nearly double, or as seven was to four. The Corporation owned the Britannia Mills, on the site of which it was proposed to extend the lighting station. For this purpose the Committee wished to provide £25,000 for buildings and £33,000 for machinery and mains.

Leicester.—The half-yearly report of the Electric Lighting Committee shows that the profits on the electricity undertaking during the past three half-years have risen from £449 and £551 to £644, and the net loss is now reduced to a nominal £679. The Council has paid £5,295 from the receipts to the sinking fund.

Leyton.—We understand that the following tenders were submitted to the Leyton School Board for the electric lighting of Kirkdale Road and Harrow Green Schools:—

	Kirkdale Road.	Harrow Green.
	£ s. d.	£ s. d.
Allingham & Fennell	344 12 0	335 14 0
H. D. Barlow & Co.	341 3 0	333 3 0
Edmundson, Limited	414 8 0	385 0 0
Moody Bros.	412 5 3	359 17 0
Spagnoletti & Crookes	449 15 0	418 0 0
Strode & Co.	427 0 0	417 0 0
Vaughan & Brown	327 0 0	306 0 0
Vulcan Electric	208 6 0	208 19 8
Westminster Engineering Company..	451 6 0	430 2 0
Woodward, W. R.	237 5 0	225 5 9
Architect's estimate was	385 0 0	360 0 0

Lincoln.—Mr. Vesey Brown has been authorised to invite tenders for (*a*) two dry back marine type boilers; (*b*) two high speed engines coupled to continuous current dynamos, motor, and centrifugal pump, and sundry accessories in accordance with his recommendation. The tender of Messrs. Ruston, Proctor & Co. at £1,145 for two dry back marine type boilers was accepted. On the question of working tramways by electricity and the cost of working the same, the Committee had considered a report by Mr. Vesey Brown, the engineer.

Lynn.—Prof. Robinson, in a recent report to the Electric Lighting Committee explained the progress which is being made with the buildings and plant for the new electricity works.

Malden.—The District Council of the Malden and Coombe have ascertained that the Board of Trade will not now grant electric lighting licenses. A committee is considering the matter.

Manchester.—A return of reproductive undertakings of the Manchester Corporation shows that the total capital on account of tramways is £199,611 and electric lighting £357,617. The amount paid off the tramways borrowing is £177,714 and off electric lighting £24,305. The average incomes for the past five years were:—Tramways £21,973, and electric lighting £39,853; and the working expenses:—Tramways £1,858, and electric lighting £18,521. The Manchester Tramways Company on Monday brought into use some new line (three-quarters of a mile) laid in the Moss Side district.

At an adjourned meeting of the Manchester City Council on Wednesday, approval was given to an application to the Local Government Board for power to borrow £500,000 for the purposes of the electricity undertaking. Alderman Higginbottom, chairman of the Electricity Committee, stated it was impossible to say how much more would be required in the future. The undertaking was growing by leaps and bounds, was most profitable, and was making a handsome return. At the same meeting the salary of Mr. F. E. Hughes, secretary to the committee, was increased from £250 to £300 per annum, and other recommendations granting advances of salary ranging from £17 10s. to £50 were passed *en bloc*.

Newport (Mon.).—At the last meeting of the Electricity Committee the total number of lights connected and applied for was stated to be 26,587. The borough electrical engineer reported upon the condition of the plant, showing that at highest load it was slightly overloaded. The Lighting and Traffic Committee having complained of inefficient public arc lighting, the borough electrical engineer has been instructed to give special attention to the matter.

Morecambe.—On Monday it was resolved to open a sub-station at the West End, in order to meet the growing requirements in that part of the town. The Council are reducing the price for current for motive purposes from 4d. to 3d. per unit. It has been decided to adopt mechanical stokers for the present boilers, so as to minimise smoke at the electricity works, and reduce the cost of fuel.

Newcastle.—The lamp inspector has reported to the City Lighting Committee showing the cost of lighting the proposed new tramway routes. To light them by gas and partly by electricity will cost a little over £3,000, while to light the whole distance (20 miles) electrically would cost £10,030 per annum.

Portsmouth.—Mr. Price, the electrical engineer, has been granted leave of absence in order to act as consulting engineer.

Radcliffe.—It has been resolved that a conference of representatives of the Radcliffe, Little Lever, Prestwich, and Whitefield District Councils be called with a view to considering the question of joint action for the provision of electricity for the lighting of the district and the adoption of the Light Railways and Tramways Act in these districts.

St. Annes-on-the-Sea.—Mr. P. J. Tideman has now entered upon his duties here as electrical engineer, and is engaged devising a scheme for the electric lighting of the town.

Sevenoaks.—A letter having been received from private parties who want to introduce electric lighting here, the District Council are favourable toward the project, and are interrogating them as to the further details.

Warrington.—A deputation from the Council recently visited Llandudno and Chester, and reported upon the electric lighting plants there.

Woking.—Mr. W. H. Trentham's report to the Urban Council on the valuation, &c., of the undertaking of the Woking Electric Light Company, is now under consideration. He estimates the principal assets as worth £11,785. The capital outlay necessary to put the whole undertaking into good order, also providing for sufficient machinery to supply a maximum output, with proper reserve power of 175 kw., is estimated at £12,520, running over three years. The first year's expenditure would be £5,216. It was stated by a speaker at last week's Council meeting, that the undertaking might be purchased for about £14,500.

Wolverhampton.—The Council has decided from April 1st next to reduce the charges for supply of current for churches and chapels to 4½d. per unit. For the consumption of 35,000 units and upwards the charge will be 4d.

Worcester.—When the electricity accounts came before the Council last week, Mr. Parker (chairman of the Electricity Committee) expressed satisfaction that he was able to present such satisfactory accounts to the Council. The loss upon the year's working had been reduced to £400 from £1,400 in the previous year, and he thought they now fairly saw their way out of the wood. He referred to the decrease in the amount of power consumed at the waterworks, which was to be regretted, as the current was consumed in the day time when it could be produced by water-power. This was, perhaps, due to the fact that less water was now pumped owing to greater economy having been practised. The average cost of the current to the private consumers had been 4½d. per unit. The value of the water-power had increased in the past year, and when a satisfactory settlement had been arrived at with reference to the Powick weir, which he hoped would be in a very short time, this would be still further increased. The new switchboard had now been got into operation, and with the new plant running, he believed there would be a considerable reduction in the coal bill. It was the intention of the Committee, so far as possible, to extend the mains to the suburbs of the city. There would be an increase of the capital account, but this would be paid for by the increase in the number of customers.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The County Council has resolved to grant permission to the Great North of Scotland Railway Company to carry across the public road the electric tramway formed between Cruden Bay Station and the hotel.

Bangor (Co. Down).—The Urban Council has unanimously approved of the proposed electric tramway scheme (the Bangor and Donaghadee electric tramway) promoted by Messrs. Drake and Gorham. Terms for the supply of current for lighting purposes will be arranged shortly. The application of the promoters came before the Grand Jury last week. The scheme includes electric trolley lines to run through the townlands of Corporation, Ballyholme, Ballymacormick, Groomsport, Balloo Lower, Orlock, Portavoe, Ballywilliam, and townsparks of Donaghadee.

Blackburn.—The Board of Trade notify that Major Cardew has reported approval of the new electric tramway system, and formal authority to commence running will be given at once.

Bootle.—The Corporation has adopted the recommendations printed in our last issue.

Coatbridge and Airdrie.—The Standing Orders Committee has thrown out the British Electric Traction Company's scheme for promoting a tramway between Coatbridge and Airdrie. The Corporation of the two burghs, who have supported this company all along, are likely now to take the matter into their own hands and apply for a Bill themselves next year.

Dublin.—The work in connection with the electrical equipment of the Tramway Company's system is now proceeding with considerable rapidity. All over the city and suburbs hundreds of men are occupied in carrying out the work of conversion from horse to electric haulage. The construction of the underground conduits for the reception of the electric cables, which was begun last Spring, is now nearing completion. The overhead equipment work is going ahead. The erection of the poles, and stringing of the trolley wire are proceeding apace on the "Rathmines to the sea," Harold's Cross, and other lines. The erection of the great central power station on Ringsend Road is getting along satisfactorily. The whole of the steel framework has been completed, and is now being rapidly covered up by a wall 18 inches thick. The tedious operation of laying the engine beds, &c., is also nearly over, and the powerful machinery destined to generate the current will soon be placed in position. Nearly all of it has arrived in Dublin, and already the erection of the elaborate steam piping has been commenced. The erection of the boilers and economisers has also begun. The conversion of some of the horse cars to motors, and the building of new electric cars, is being pushed forward with energy at the company's workshops in Inchicore. New cars are being built. The *Irish Independent* says that the central power station is expected to be finished by June next; but it is too much to hope that the whole system will be electrically equipped by that time. Still, there is little doubt that by the end of the year electric traction will be in operation on most of the lines.

Dudley and Stourbridge.—The proposed electric tram system, and the branch line to connect the present Dudley and Wolverhampton steam tramways with the Stourbridge line, were explained to the Dudley Town Council last week. Representatives of the Council have interviewed the British Electric Traction Company regarding the company's Bill to extend light railways in the district. Owing to the opposition of frontages, &c., the company had decided to abandon the proposed route along Priory Street and Stone Street, Dudley, and to make the new line along Stafford Street to a connection with the Stourbridge line near St. Thomas's Church. The Corporation would supply the electrical energy required on the line, and would have the option of purchase at the same period as for the remainder of the Wolverhampton line. It was left in the hands of the committee of the Council to decide whether the poles along Queen Cross should be erected in the middle or at the sides of the road.

Electric Railways in Germany.—An exchange says that according to the United States Consul at Hanover, up to the end of the year 1891, the number of cities in the German Empire enjoying the advantages of electric street railways, was 3; up to the end of 1892, 5; 1893, 11; 1894, 19; 1895, 32; 1896, 44; 1897, 61; and on September 1st, 1898, no less than 68. In 35 other cities or districts, railways are in course of construction, or finally determined upon. The entire length of electric lines in operation in Germany on September 1st, 1898, was 885 miles, the number of motor cars was 3,190. The length of the new lines in course of construction, or about to be begun, at that date was 677 miles. Most of the large industrial cities in Westphalia and the Rhine Province are connected by a network of electric roads, which serve not only for passengers but for goods traffic.

Glasgow.—Last week we printed the recommendations of the Tramways Sub-committee respecting Mr. Parshall's report *re* electric traction. The Electricity Committee on 10th inst. held a special meeting to consider the report by the sub-committee as to the conferences they had had with the Tramways Sub-committee as to the generation and distribution of current for the tramways. The Electricity Committee approved of the report, which reads as follows:—At the first conference which took place between the sub-committees of the Tramways and Electricity Committees on 15th ult., it was admitted that the Electricity Department could satisfactorily and economically generate electric current for the Tramways Department. It was contended by the sub-committee of the Tramways Committee, on the advice of the expert employed by the Tramways Department, that what is commonly described as high speed plant is not suitable for the driving of electric tramways, and that continuous current plant, worked at a pressure of 500 volts, whether of the high or low speed type, is unsuitable for the special conditions which require to be met in the Glasgow tramways scheme. The expert of the Tramways Department recommended the adoption of low speed plant, generating high tension alternating current, on the multiphase system, and as this type of plant will not be most economical for the use of the Electricity Department for the ordinary supply of electricity for lighting and generating purposes, except, perhaps, to some extent for special purposes, in order to allow of reaching long distances, it is clear that if the Tramways Department adopt this kind of plant, it could not, even if placed in the same station, be interchangeable to any appreciable extent with the ordinary continuous current plant used by the Electricity Department. It was not, however, admitted by the sub-committee of the Electricity Committee that, as a general principle, high speed plant is not suitable for supplying current for tramways purposes, this being a purely engineering question, about which there is a difference of opinion among engineers. The Sub-Committee of the Tramways Committee were strongly of opinion that it was desirable for the whole of the generating plant required for tramways purposes to be entirely in the hands of the Tramways Department, and under the management and sole control of their general manager. Bearing in mind the gigantic proportions of the scheme of the Tramways Department, and the large amount of generating plant which they consider they will require, it is evident that no greater economy in the works cost of production is to be hoped for by combining the generating plants of the Electricity and Tramways Departments, although there might be some saving in the cost of distribution; and the Sub-Committee of the Electricity Committee are of opinion that, in view of the whole circumstances of the case, it is desirable, as a matter of expediency, that the Tramways Department should be entirely responsible for the whole tramways undertaking, including the electric generating and distributing plant and mains, if a system such as that recommended by their expert is to be carried out. The Sub-Committee of the Electricity Committee are of opinion, and have to recommend, that if the Tramways Department is entrusted with the supply and distribution of electricity for their own purposes only, they should be required to run all the mains, feeders, returns, and conductors, or leads of any and every kind, which may require to be laid underground in the space between and under the tramway rails. The Electricity Committee have carefully avoided running any of their mains or conductors of any kind along the space beneath the tramway rails as far as possible, recognising it as a space particularly set aside for the purpose of all tramway electric mains and other conductors, no matter what department may lay and maintain them. It is, of course, impossible for the Electricity Department to avoid passing beneath the tramway rails in some cases—as, for instance, at street crossings—and it may prove to be equally impossible for the Tramways Department to confine the routes of its own mains under all circumstances to the space beneath the rails; but there is no reason why the recommendation made in this report in regard to this matter should not be observed as a general regulation.

A special meeting of the Corporation was called for yesterday to consider Mr. Parshall's report. Mr. Parshall estimates that the cost of constructing a three-phase generating station containing four 2,500-kw. units, including buildings and plant, together with plant for sub stations located in the existing car barns and stables, and including high tension cables, will be £316,000, while he estimates the cost of construction for five generating stations of approximately 2,000 kw. capacity at £390,000.

Greenock.—The Police Board has resolved to oppose the proposals of the Greenock and Port Glasgow Tramways Company relative to the working of the tramways by electricity.

L.C.C. and Electric Traction.—Last Tuesday's *London Gazette* contains notice of the L.C.C.'s intention to apply for leave to introduce a Bill in the present session of Parliament for various powers regarding its tramways, including the construction and alteration of various lines to adapt them for electric traction, the purchase of land for generating stations at Streatham Hill, Camberwell, and Greenwich, and power to use the conduit, trolley, or surface contact system.

Leeds.—In July electric cars will probably be running on the Chapeltown and Headingley routes. The *Leeds Mercury* says that rapid progress is being made with the extensions to the electric generating station at Crown Point. The existing plant consists of two boilers, two 400-H.P. engines, and a couple of dynamos. The additional plant will include four new boilers (two of which are already in position), two 1,200-H.P. engines, and further dynamos. When all is finished the station will be able to supply power sufficient to run something like 100 electric cars. Messrs. Fowler have the contract for the engines, Messrs. Greenwood & Batley that for the dynamos, and Messrs. Clayton, Son & Co. are supplying the boilers.

The Highways Committee is commencing the work of re-laying the tramway lines in Tong Road. The present single track will be removed, and double lines will be laid down on concrete. The rails will be bonded, and everything will be done to facilitate the adoption of electric traction when the Corporation resolve to extend that system to the districts of Armley and Wortley.

Light Railways.—The Board of Trade has, after modification, confirmed the following light railway orders:—North Shields, Tynemouth and district, and Stourbridge to Kinver.

Newcastle.—A special meeting of the City Council on 8th inst. resolved that the working of the trams should be retained in the hands of the Corporation.

Portsmouth.—The Tramways Committee has, in connection with the acquisition, decided to engage an expert for the valuation, under the Land Clauses Act, of the lines between Greetham Street and Clarence Pier.

Rhyl and Prestatyn.—On 8th inst. the Light Railway Commissioners held an inquiry at Rhyl respecting an application made by the Rhyl and Prestatyn Light Railway Company, Limited, to lay a light electric railway between these seaside resorts. The length of the line would be 3 miles 5 furlongs, of which 2 miles 7 furlongs would be a single line, the remainder being double track. The line will be worked on the overhead trolley system, and the gauge would be 3 feet 3 inches, and the estimated cost is £26,000. Lord Jersey notified that the Commissioners would recommend the issuing of the order.

Roker to Houghton-le-Spring.—It is stated that the United Service Tramways Company have been prospecting in the Sunderland district, with a view to erecting a light electric railway. They have decided, it is said, to make application for permission to lay down a line from Roker to Houghton-le-Spring, tapping places like Fence Houses, Penshaw and Newbottle.

Teignmouth.—A proposal is on foot for a light electric railway between Teignmouth and Torquay.

Walsall.—Messrs. Dickinson & Co., Birmingham, having requested the Town Council to favourably consider the proposal to construct a light railway from Perry Barr to Walsall, the town clerk has been instructed to reply that the Council will support the proposal conditionally.

Wrexham.—The Town Council will only consent to the order of the Wrexham District Tramways Company on the understanding that the tramway was to be worked by electric power.

TELEGRAPH AND TELEPHONE NOTES.

Automatic Telephones.—It is stated that the Post Office authorities at Berlin have decided to experiment with penny-in-the-slot telephones. A few instruments have been already fitted up in post offices.

Dover Telephones.—The Council is inviting other boroughs to co-operate in securing a reduction of the limit of towns to which telephone licenses may be granted, to below 50,000 population.

Germano-Roumanian Telegraphs.—Among the more important provisions of a new treaty between Germany and Roumania, says the *Times*, are those relating to the railway and telegraphic communications between the two countries. The treaty provides for the construction of a new telegraph wire between Bucharest and Berlin by way of Galicia. The wire will cross the German frontier at Myslowitz and the Roumanian frontier at Burduzheni. It will be worked directly between the two capitals by means of the Hughes apparatus. The wire will be continued from Bucharest to Kustendji, and thence by a submarine cable to Constantinople. The construction of the cable will be entrusted to a private company, the statutes of which shall be approved by the German and Roumanian Governments. The Roumanian Government will grant the company the usufruct of land in Kustendji. The working of the cable wires on Roumanian territory is to be in the hands of the Roumanian Postal Administration in Bucharest, but the supervision of the administration of the company rests with the German Imperial Post Office. The concession to the company is for a period of 30 years, with prior rights of renewal, during which 30 years the Roumanian Government will not make any other concession for a cable between Roumania and Turkey. That Government further undertakes to pay the company a yearly subvention of 50,000 francs, which may be reduced by 5,000 francs for each 10,000 francs by which the gross receipts of the company in any year exceed 50,000 francs. The German monopoly in the cable is welcomed as being "of great importance for the commercial interests of Germany in Asia Minor." The construction of the cable will assuredly give employment to German industry, and there is a certain prospect that the German control of the wire will be permanent.

Klondyke Telegraphs.—It is stated that the Dominion Government has decided to construct immediately a telegraph line from Lake Bennett to Dawson City. Lake Bennett is already connected by telegraph with Skagway.

Swansea Telephones.—The Corporation has this week decided to advertise for tenders for the contract and maintenance of the Corporation telephones.

The Telegraph Wire Export Trade.—The activity which prevailed in the export trade of this country in telegraph wire and apparatus connected therewith during the first month of the year has not continued during February, the returns just issued showing a total value of the shipments during the month of only £59,424, as compared with £311,466 in January last, and £75,276 in February, 1898. For the first two months of 1899 the aggregate shows a large increase, a total of £370,890 being recorded as compared with only £113,205 in the first two months of 1898.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	June 11th, 1898 ...	...
French Company's cables—		
New York-Hayti ...	Feb. 10th, 1899 ...	...
Paramaribo-Cayenne ...	Feb. 10th, 1899 ...	...
Cayenne-Pinheiro ...	March 10th, 1899 ...	...
Dakar-Bathurst	Feb. 9th, 1899 ...	...
Landlines.		
Communication with Interior of Nicaragua, except Rivas	Feb. 24th, 1899 ...	March 13th, 1899.
Indo-European lines (between Odessa and Kertsch	March 6th, 1899 ...	March 9th, 1899.
Saigon-Bangkok	March 7th, 1899 ...	...
Majunga-Tananarive ...	March 14th, 1899 ...	...
Moulmein-Bangkok	March 15th, 1899 ...	...

The Telephone Service.—It was stated some weeks ago that the Council of the Institution of Electrical Engineers had appointed a committee of members of the institution to consider and report on the future of electrical engineering in these kingdoms in the branch of telephony. At the ordinary meeting of the institution on the 9th inst. it was announced that the council had adopted the following report and rider thereto, submitted by the committee:—"That in the opinion of this committee it is undesirable, from the point of view of the progress of electrical engineering, for the purely local telephone industry throughout to be held as a monopoly; or that legislation on the future of telephony in these kingdoms should discourage the undertaking of exchange systems within telephone areas by independent enterprise. The committee is therefore of opinion that the council should strongly urge on the Government that such legislation may have the further effect of removing existing disabilities to the carrying out of the recommendation." It was also announced that a copy of this report had been forwarded to the Government.

The Telephones Bill.—The *Standard* believes that it is probable that the provision in the Telephones Bill which only allows boroughs of 50,000 and upwards to set up their own telephone systems will be dropped. The general feeling is that any borough which is able to fulfil the necessary conditions should be allowed to establish a telephone exchange within its own boundaries.

The Telephone Question.—At the Court of Common Council last week, when the Guildhall resolutions were brought forward, it was stated that the decision of the Government as announced by Mr. Hanbury would largely affect these resolutions. Mr. Morton said that the thanks of the people of London, indeed, of the United Kingdom, were due to the Government for the steps they were to take.

The Bristol Stock Exchange is protesting against the Government telephone measure as explained by Mr. Hanbury last week. It regards the proposals as an unwarranted attack upon the interests of capital.

Tunbridge Wells Telephones.—With reference to Mr. Hanbury's suggestion that only towns with at least 50,000 inhabitants would be able to start municipal systems, the Corporation Telephone Committee considers that this, if adopted, will work against a proper development of the telephone system throughout the country, and it would be best that any Town Council, even if representing less than 50,000 residents, should have the same local telephone chances as the larger urban areas. Therefore the committee advises the Council to apply forthwith for a license to work a municipal system of telephones within the area now served by the National Telephone Company, including Tunbridge Wells, Tonbridge, and Southborough.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—The Corporation wants tenders for two Babcock boilers, one 180-kw. steam dynamo, and one 75-kw. balancing set. See our "Official Notices" this week.

Aberdeen.—March 29th. The Corporation wants tenders for permanent way, overhead line work, feeder and test cables, cars, switchboard, &c., for electric tramways. See our "Official Notices" March 10th.

Ambleside.—Tenders are, according to an exchange, about to be invited for gas engines, generators, boosters, switchboard and battery, and mains for electric lighting at Ambleside. Intending tenderers should send their names to the engineers, Messrs. Hopkinsons & Talbot, 26, Victoria Street, S.W.

(*Continued on page* 425)

THE CITY OF LONDON ELECTRIC LIGHTING COMPANY'S WORKS.

(*Concluded from page* 383.)

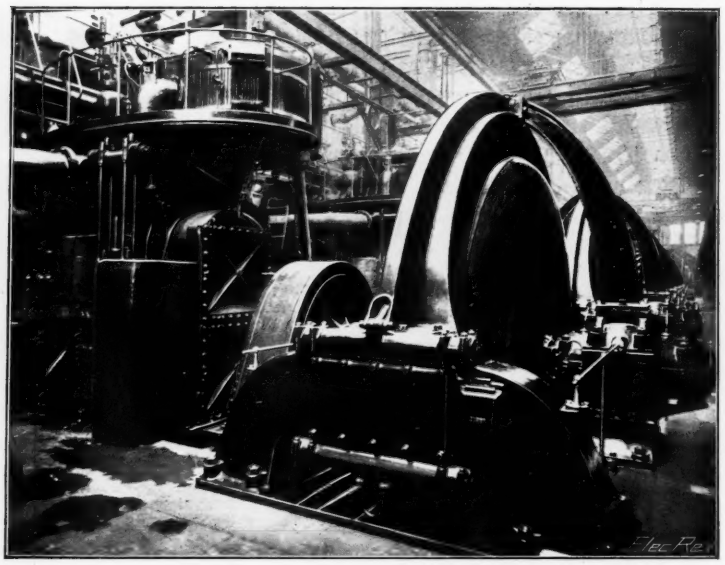
The most recent additions to the alternating current plant are two Ferranti fly-wheel alternators, one of which is shown in the illustrations given last week. The engines are capable of developing 2,500 H.P., and the cylinders are H.P. 38-inch L.P. 68-inch by 30-inch stroke, the steam pressure being 150 lbs. They run at 150 revolutions. Overhung cranks are employed in these engines, the discs being shrunk on to the shaft. The shaft runs in two main bearings of spherical white metalled type one carried on H.P. and one on L.P. bed-plates. The weight of the wheel is taken on roller bearings hung on springs resting on brackets carried on the bed-plates. The weight of the wheel complete with shafts, discs, bobbins, and bolts, &c., is 50 tons, and is 16 feet in diameter. The overall periphery of the armature is 20 feet. In constructing the fly-wheel, it was first of all cast in two halves with 8 cast arms, the boss of casting being split between each. A steel boss is shrunk on to the shaft and is enclosed in cast-iron boss of wheel, into which are screwed and shrunk 8 steel tie bolts which are bedded into recesses in the rim of the wheel. The two halves are held together by steel links shrunk on to bosses cast on inside the rim. The whole wheel is held to the shaft by two steel rings shrunk on to turned registers on cast boss of wheel, no keys whatever being used. Forced lubrication is employed throughout, and is distributed from a tank at a pressure of 50 lbs. The oil leaking out falls into the centre of the bed-plate, where it is strained before passing into oil tanks under bed-plates.

The valve gear is driven from vertical shaft by a second motion shaft driven from crank pin (which also drives valveless oscillating oil pumps) through gearing which reduces speed of vertical shaft to half that of engine. There are two steam and two exhaust grid valves to each engine, H.P. and L.P. The H.P. steam valves are driven by Ferranti patent trip gear, consisting of eccentrics on vertical shafts working a rocker arm; this moves a gun-metal cross-head carrying engaging teeth, which strike in to catch blocks on valve spindle. When the rocker is in its two extreme positions and moving the valve from its central position, it admits steam until the engaging teeth are thrown out of gear by a tripping piece working over a graduated wedge. The position of this wedge is controlled by a dead-weight governor driven through gearing from the second motion shaft, and thus the point of cut-off is regulated. The valve, when moved from central position, compresses two springs on the further end of the cylinder, which, when the releasing takes place, returns the valve to a central position, the blow being fended by a piston on the valve spindle working in an oil dashpot. The L.P. steam valves, and both H.P. and L.P. exhaust valves, are actuated by cams on vertical shaft, which also produce similar motion. The lubrication to valve gear is by drip feed boxes filled from main oil supply, the valve gear boxes draining into the engine column.

Benetfink Sub-station.—Transformer and Distributing Switches shown at each Side; Main High Tension Board at the End.

The clearance spaces for steam are limited to the actual piston clearance, the valves admitting and exhausting direct on to top or bottom of piston. The pipes connecting the H.P. and the L.P. cylinders form a L.P. receiver. The engine by the limited number of its bearings and efficient lubrication is claimed to be frictionless, thus giving a low consumption per I.H.P. The alternator is of the usual Ferranti non-inductive armature type. The armature consists of 80 patent Ferranti coils made up in pairs and carried on ebonited bolts sulphured

into pockets cast into rim of wheel, thus giving a very high insulation resistance. The two halves of the armature are in parallel. The inner leads through insulated connections sulphured into boss of wheel to collector gear on low pressure side. The outer is earthed on to the rim of the wheel, brushes bearing on shaft on H.P. side and earthed again on to H.P. bed-plate. From collector gear two concentric cables are lead away to switchboards, the outer of the concentric main being connected to low pressure bed-plate, thus giving a complete earthing of all parts of the plant.



Brush Alternator and Engine.

The field coils are of bare copper, wound on edge on each pole, 80 each side. The pole pieces are capped with micanite caps moulded on. The coils are magnetised from a separate exciter of 30 kilowatts 300 amperes × 100 volts driven off a rope pulley mounted on boss of wheel from H.P. side.

In the southern section of the works are the series of Brush alternators direct driven by the original type of Brush engine. Some of these machines have been remodelled, the armatures now consisting of 78 patent Ferranti coils in series made up in pairs, the inner and outer being separated by a dummy pair of coils. The coils are supported by bobbin carriers sulphured into a gun-metal frame bolted on to the original cast-iron armature frame.

A special method of ventilating these machines has been introduced, which takes the form of gun-metal cowls placed on the exterior of the field magnets casting. As the magnet revolves air is drawn through the cowls and passes to the interior of the field. The field winding has been to some extent re-arranged.

The northern section of the works is entirely occupied by Thomson-Houston machines, of which type there are 10 units, eight of which each have a capacity of 400 kw., and two of 350 kw. each.

The former sets have each 40 poles, and run at a speed of 300 r.p.m.

This machine has fixed field coils and a rotating armature of the ironclad type, the coils being wound in slots cut in the core, and held in position by wooden wedges; the whole of the winding is below the surface of the core, the idea being that this arrangement makes it difficult for the coils to sustain mechanical injury from vibration. The ends of the armature winding are led out to the collector rings, which are mounted on solid ebonite bushes, one being placed at each end of the shaft. The bearings are of the self-oiling spherical type. The field magnets consist of spools wound on formers, which are slipped over the pole pieces and easily secured in position. The field casting is divided on the horizontal centre, and in some of the later machines the field castings are laminated throughout.

These alternators are connected direct by means of a solid coupling to the crankshaft of a Willans engine of the SSS type having the following leading particulars:—

Number of cranks ...	3
Diameter of low pressure cylinders (3)	30·3 inches.
Diameter of intermediate cylinders (3) ...	19·7 „
Diameter of high pressure cylinders (3)	12·6 „
Length of stroke... ...	11·4 „
Speed	300 r.p.m.
Maximum I.H.P.	700
Steam pressure	150 lbs. per sq. in.

It will be seen from our previous illustrations that separate condensers and pumping engines are connected to some of the engines, though the whole station is now run condensing.

The engine and alternator are mounted upon a massive combination cast-iron bedplate of box pattern, placed upon a solid concrete foundation.

The two smaller units of 350 kw. are somewhat different in design, as each machine is driven by two Willans engines of 3 I type, connected one at each end of the armature shaft. The general design of the alternators is similar to that of the 400-kilowatt machine.

The idea in having two engines to each alternator was to secure a higher efficiency at light loads—one engine only being used when the alternator had half load or less.

The above engines, with their alternator, are mounted upon a solid brick foundation, but have no connection between the bedplates other than that through the shaft.

With the exception of the Ferranti plant, the exciters are run entirely separate from the alternators, some being driven by Browett-Lindley engines. The exciting current from these machines is taken to a special switchboard, the alternators being then excited from the omnibus bars of the exciting board.

Pumping Station.

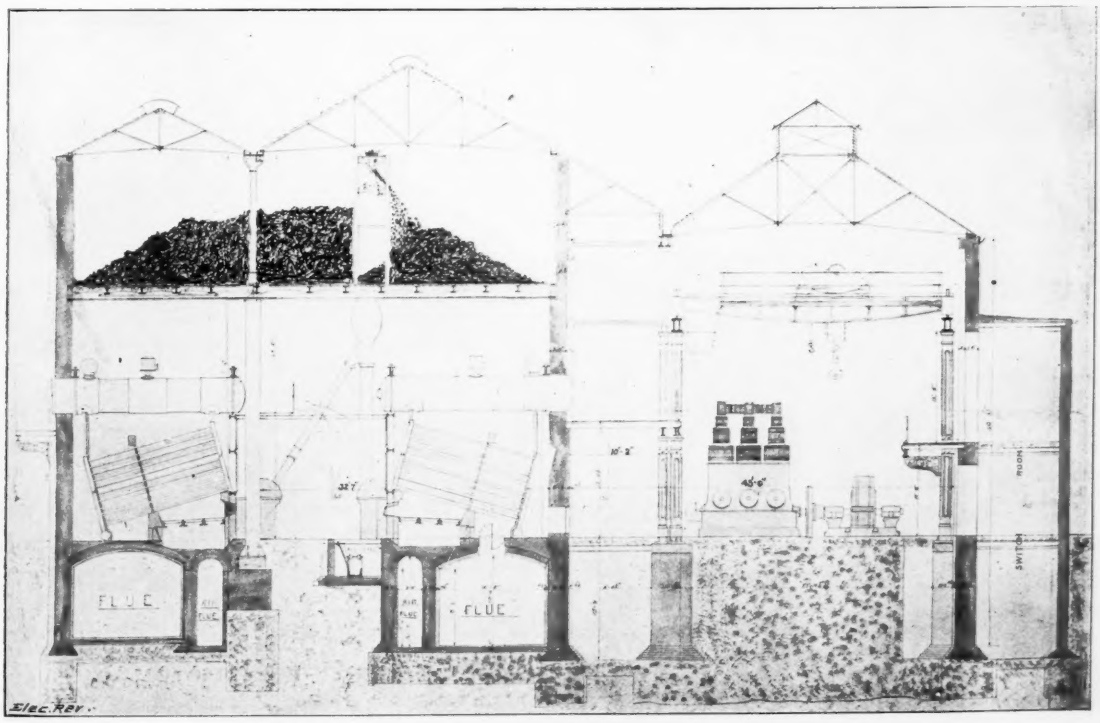
There are two main switchboards, each one practically consisting of two boards placed back to back. The switching

gear on the side facing the engine room controls the alternators and their exciting circuits, and the switching gear on the opposite side controls the high tension feeders going out from the station to the transformer sub-stations.

The switch gear is of the Ferranti single-pole type. The original switch gear was designed with 64 panels, 32 being included in the north, and 32 in the south end of the station. Of these, 14 panels on each board were to deal with the machines, 14 at the back of each board with the circuits, and the remaining eight panels were to be used as inter-connectors between the two boards of 32 panels, or to split up these boards in their turn to four systems of 16 panels, with synchronising arrangements to enable the same to be joined in parallel again. The synchronisers are of the usual patent Ferranti type, and are magnetised on one side from a bus bar, and the other from a synchronising bar (connected through a fuse to a H.T. voltmeter), on to which any incoming machine may be connected through an oil break fuse quickly and accurately. Two sets of synchronising gear are provided for each board, irrespective of synchronisers for inter-connectors. The high tension voltmeters are White's multi-cellular type, with large dials, the synchronising voltmeters by Hartmann & Braun hot-wire type; lamps being also provided. The main ammeters are of the patent Ferranti type with vertical scales highly insulated and are always connected to the inner bus bar. Any portion of the outer or inner bus bar can be separated so as to isolate any panel. These boards have been extended by the addition of 16 panels to the circuit side of the boards, making in all 80 panels.

Watling Street Sub-station.—High Tension End.

The fuses which protect the alternator and feeder circuits are of the usual Ferranti oil-break type consisting of a trough filled with oil having a bridge piece in the centre over which the fuse wire is stretched and connected through springs to the contacts at the bottom of the trough; the moment the fuse wire melts the ends are drawn down by means of these springs into the oil and the arc is immediately extinguished. The outer connections on the fuse trough consist of knife contacts which are pushed into laminated springs mounted on the back of the panel to which the dynamo terminals are connected. The main switch consists of a double blade making contact with laminated metal blocks; it also has a second pair of contacts inside a small cylinder containing oil. The main contacts are first broken by means of a long handle attached to the lever of the switch, which, when it reaches a certain point, disengages a powerful spring placed inside the above cylinder, thus releasing the second contacts, which



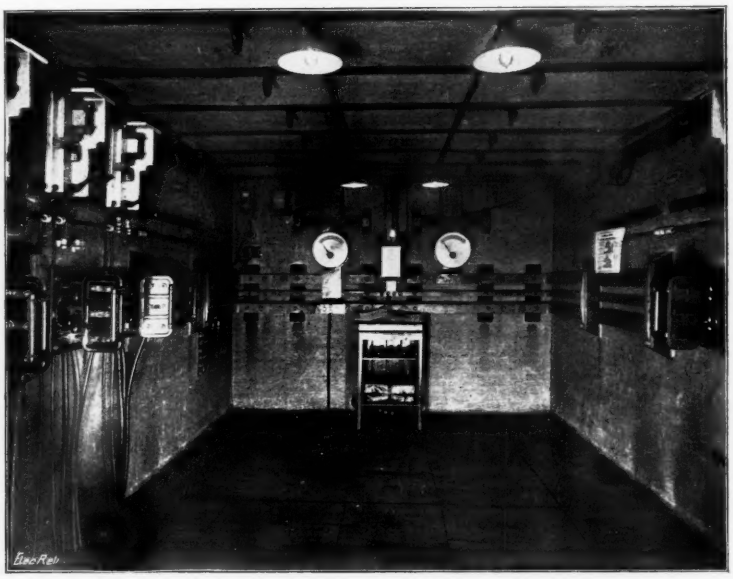
End Elevation of Bankside Works.

break circuit very rapidly through oil, thus extinguishing the spark instantaneously. As we have already said, the switch is arranged so that in its mid position between off and on it makes contact with a small terminal connected to the synchronising bus bar, thus enabling the machine to be put in synchronism through the transformer with the other machines connected to the bus bars. As soon as synchronism is obtained the switch is closed and the machine thrown directly on to the bus bars.

The regulation of the machines is effected by varying the resistance in the exciter field circuits.

It should be pointed out that there is no difficulty in running any machine in parallel with a machine of another section as is frequently done.

The high tension current from the central station is carried to the transformer sub-stations by lead sheathed concentric paper insulated cables drawn into wrought-iron pipes, troughs, and conduits, and are carried across the river by two routes, some going over Southwark Bridge and others over London Bridge and thence by various routes to the sub-stations where they terminate in the H.T. feeder boards. High tension interconnecting cables are also carried from each sub-station to four neighbouring stations, so that the whole of the stations can be connected up together on the primary side if desired, and each can assist the other when required. These, as interconnecting cables, are of the same type as the H.T. feeders and are laid in iron pipes.



Watling Street Sub-station.—Low Tension End.

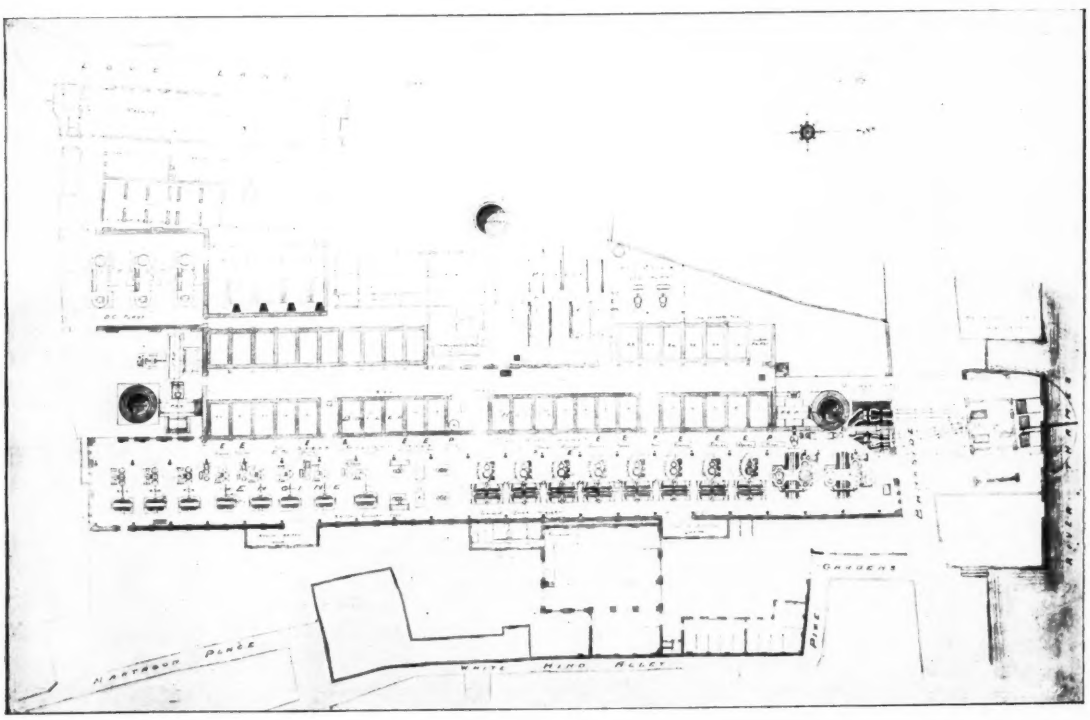
The low tension mains are on the three-wire system, each transformer station supplying current through secondary feeders to a small network of distributing mains.

The feeders and distributing mains consist of triple concentric lead sheathed cables insulated with paper, some of these cables are drawn into iron pipes and others laid in Callender's bitumen casing.

Joints for house services and feeder connections are made in cast-iron boxes fitted with metal connections and filled with resin oil and bitumen, these boxes are placed in brick chambers, fitted with iron covers faced with cement, laid flush with the surface of the pavement.

The arc light mains consist of paper cables which are drawn into wrought-iron pipes, the circuits are arranged so that the lamps are connected alternately to separate circuits, so as to prevent any street being left in darkness should a circuit break down.

As we have pointed out, there are 23 sub-stations, which are in most cases special brick chambers, built below the surface of the road, and having manhole doors which are



General Plan of Bankside Works.

brought up flush with the pavement on the footway. The transformers are placed at the bottom of the chamber, and stand on the floor beneath an artificial floor consisting of steel girders covered with oak boards laid out in squares of such a size that each square completely covers one transformer—thus giving easy access to the transformers—which can be raised to the floor level by means of a small chain block which is hooked into the eye bolt in the roof girder immediately over the transformer.

The main switchboard controlling the transformers consists of solid oak battens fixed to the wall by Lewis bolts. Iron bars are screwed to these timbers, thus forming a skeleton framework to which the marble slabs carrying the switches and fuses are bolted.

The primary switching gear is placed at the top of the board, the secondary switching gear coming immediately below it. The primary cables are insulated with vulcanised rubber, the joints and main conductor being covered in one operation. The bus bars themselves are supported by ebonite cleats.

The secondary bus bars are of bare copper strip laminated, and in later cases with an air space between, and are held in massive solid ebonite cleats bolted to the oak framework.

The primary feeders from the central station are led into the H.T. feeder board placed at one end of the sub-station, and are connected through double-pole H.T. switches and fuses to the main bus bars which are connected to the H.T. transformer bus bars above described, and are also connected through plug fuses to the inter-connecting mains which are carried to four neighbouring sub-stations, so that in the event of one or more of the main feeders breaking down, current may be obtained from these sub-stations.

The secondary bus bars are in some cases carried to the ammeter board at the other end of the chamber and are there connected through the ammeters to the low tension three-wire feeders.

The whole of the switching gear is worked by hand, one attendant having charge of three or four stations which he visits in turn at frequent intervals.

We are given to understand that mains are laid throughout almost every street, court, and alley within the City boundary in spite of the almost insuperable difficulties of finding space for the necessary pipes and conduits to contain the service wires.

The company has recently arranged a scheme of free wiring on the basis of a moderate rental on the actual cost of the wires and fittings, and have so far met with very gratifying encouragement. A number of premises are now wired upon this method which would otherwise have had to remain without it, as owing to short leases held by present tenants, and the apathy or indifference of the landlords to spend the necessary money, it was not possible for a supply to be arranged, and though the company takes some risk in finding the necessary capital, the enterprise shows every desire on the part of the company to do all they can, not only to encourage the use of electric light, but also to bring it within the reach of all.

In the old pioneer station of the company, the position of which is shown on the plan of the works, the whole of the arc lighting plant is fixed; these comprise Thomson-Houston and Brush arc lighters driven by Robey and other engines. There is also a direct current machine driven by a Willans engine, while other direct current machines are being erected, two of which will be driven by Robey engines which formerly did duty at the Woolquay works.

The Victoria Accumulator.—In regard to last week's article on the "Victoria Accumulator," a correspondent writes with reference to the diagram :—"The time (hours) indicated on the base line does not agree with the values of $\frac{\text{watt-hours}}{\text{watts}}$ indicated by the curves. There must be a mistake somewhere. 'Normal rate of discharge per square inch of active positive surface, 7.' This is, no doubt, a misprint for 0·07. Even this is comparatively a very high value."

CONTRACTS OPEN AND CLOSED.

(*Continued from page* 420.)

Barking Town.—March 27th. The Urban Council wants tenders for a 80-kw. steam dynamo (vertical high speed enclosed engine and two-pole dynamo), with pipe-work and accessories. See our "Official Notices" March 10th.

Belfast.—The Harbour Commissioners want tenders for the construction and erection of two overhead tramways on the Queen's Quay, Belfast. Specification, &c., may be obtained from the Harbour engineer, Mr. G. F. L. Giles.

Bury.—March 20th. The Electric Lighting Committee wants tenders for a Lancashire boiler with steam and other pipes. See "Official Notices" March 3rd.

Derby.—March 30th. Tenders are wanted for an overhead hand crane for the electricity works. See our "Official Notices" this week.

Doncaster.—March 28th. The Corporation wants tenders for three Lancashire boilers, several sets of steam dynamos, overhead crane, condensing plant, storage batteries, electrical instruments, cables, street boxes, &c. See our "Official Notices" this week.

Edinburgh.—April 3rd. The Corporation want tenders for water-tube boilers. See "Official Notices" this week.

Gillingham.—March 23rd. The District Council is inviting tenders for wiring and fitting the Technical Institute for electric lighting. Particulars from the architect, Mr. F. Smith, Bank Chambers, High Street, New Brompton.

Lewes.—March 24th. The Corporation is prepared to receive offers from those willing to establish an electricity supply undertaking. See our "Official Notices" February 17th.

Morecambe.—The District Council wants tenders for mechanical stokers for two Babcock boilers. See our "Official Notices" this week.

Moscow.—The City Council (says *Commercial Intelligence*) announces that all contractors who are desirous of bidding for the construction of electric railroads in the city must make application to the City Council not later than April 12th. The sum of 750 roubles (£75) must accompany each application. The Council will give all parties presenting applications the terms and conditions of the concessions, with all necessary drawings and statistics as to the working of the tramways in Moscow for the past five years, profits of the different localities, list of lines existing, and approximate prices for making out the estimates. For foreign bidders there are issued copies of the contracts printed in foreign languages, which will be sent on demand to all electrical companies. Copies will be sold to all applicants desiring particulars of the contract to be issued. The date of presenting the final tenders will be October 1st, 1899.

Poplar.—April 25th. The Board of Works wants tenders for engine and boiler house plant, battery equipment and street lighting. See "Official Notices" this week.

Rothsay.—March 27th. The Town Council wants tenders for 220 H.P. coupled engines and dynamos, switchboards, cables, arc lamps and posts, feed pump, steam and exhaust pipes, &c See our "Official Notices" March 10th.

Southend-on-Sea.—April 6th. The Corporation wants tenders for the "temporary" transfer of their 1891 Electric Lighting Order. See "Official Notices" March 3rd.

Spain.—April 20th. The municipal authorities of Santiago are inviting tenders for the supply and erection of the plant for a central power station to be erected near the town to utilise the water-power of the River Tambre for the generation of electrical energy for lighting and power purposes. Particulars may be obtained from, and tenders are to be sent to, El Presidenté del Consejo de Administracion Santiago, Spain.

Stockport.—March 23rd. The Corporation wants tenders for the supply, erection, and maintenance for 12 months of 36 continuous current arc lamps. See our "Official Notices" this week.

Stockport.—March 24th. Tenders for electric lighting the Stockport Sunday School are invited to be sent in to the Secretary not later than March 24th.

Sunderland.—March 30th. The Corporation wants tenders for India-rubber covered cables, cast-iron and wrought-iron pipes and street service boxes, stoneware castings and bearers, house fuse boxes. See our "Official Notices" March 10th.

Tynemouth.—The Corporation wants tenders for boilers, economisers, condensers, pumps, pipe work, water cooler, crane, switchboards, accumulators, cables, and traction steam dynamo. See our "Official Notices" this week.

CLOSED.

Burnley.—The Corporation has placed the order for switchboard with Messrs. Williamson & Joseph, Limited.

Clyde.—The trustees of the Clyde Navigation have accepted tenders as follows for an electric lighting installation:—Messrs. G. E. Belliss & Co., Limited, for one engine; Mirrlees

Watson & Yaryan Company, one engine; India-Rubber, Gutta-Percha and Telegraph Works Company, two dynamos.

Ealing.—The Ealing Urban District Council has renewed the contract with Messrs. Stuart & Moore for the maintenance of its telephone and fire alarm systems for a further period of seven years at £140 per annum.

Plymouth.—The tender of Messrs. Robinson, Sadler and Co., for installing the electric light at the Free Library for £170 7s. 6d. has been accepted.

West Hartlepool.—The Council has accepted the Callender Cable Construction Company's tender for feeders, mains, &c., at £8,770.

FORTHCOMING EVENTS.

Saturday, March 18th.—At 11 a.m. Institution of Electrical Engineers. Students' visit to the Langdon-Davies Electric Motor Company. Meet at the works, 101, Southwark Street, S.E.

Wednesday, March 22nd.—At 8 p.m. Society of Arts. "Electric Traction," by Philip Dawson. Sir Frederick Bramwell will preside.

At 7.30 p.m. Institution of Electrical Engineers. Students' meeting. Paper on "The Synchronising of Alternators," by R. P. Howgrave-Graham and M. R. Gardner, students.

Thursday, March 23rd.—At 8 p.m. The Institution of Electrical Engineers. "The Hissing of the Electric Arc," by Mrs. Ayrton. Illustrated by experiments.

Friday, March 24th.—At 5 p.m. Physical Society. 1. "On the Criterion for the Oscillatory Discharge of a Condenser," by Dr. Barton and Prof. Morton. 2. "The Minor Variations of the Clark Cell," by Mr. A. P. Trotter.

Saturday, March 25th.—At 3 p.m. The Institution of Junior Engineers. Visit to the Testing Station of the British Fire Prevention Committee at Hanover Gate, Regent's Park, London.

CANTERBURY CORPORATION ELECTRICITY WORKS.

With the history of the electric lighting question in its relation to the ancient City of Canterbury, and with the technical features of the municipal undertaking which has been established for the purpose of affording a supply of electrical energy to the citizens, readers of our last issue have doubtless become acquainted. The formal inauguration of this undertaking took place last Friday, and now Canterbury ranks as one of the numerous places which have electricity works in regular operation.

The company at the ceremony numbered between 200 and 300, and included the representatives of all the principal towns in the south-eastern counties. There was a pretty large contingent from London too—Hackney vestrymen, who have a special interest in electric lighting just now, turning up in great force. Special saloon carriages had been provided, and the journey down was thereby rendered specially comfortable. An informal luncheon at the "Royal Fountain" Hotel was the real beginning of the ceremony, but we were spared the usual set speeches and customary eulogisms of everybody connected with the undertaking peculiar to these ceremonies, a relief for which many of us were profoundly thankful.

At the electricity works everything was in spick and span condition. Mr. Robert Hammond, the consulting engineer, was, of course, in his element in conducting the formal inspection of the works. Here he talked to his heart's content, describing the various portions of the plant, the conditions under which it had to work, what it was expected to do, and the results it was anticipated would be achieved, and so on, imparting also to the company a vast amount of information on electric lighting in general, all without "the usual fee of 5 per cent." His descriptions were interesting and instructive to engineer and layman alike. When he had talked himself hoarse, Alderman Mason, the chairman of the Electric Lighting Committee, switched on the light in the works, and declared the works open for the public supply of electricity to all who needed it in the city.

High tributes were paid to the consulting engineer and the contractors and their representatives, and everybody drank heartily the toast of "The Success of the Electricity Supply Undertaking." That is as it should be on such occasions. Now it is the engineer's turn to show that the undertaking is capable of effecting a thoroughly practical realisation of the hope expressed in that toast.

NOTES.

(*Continued from page* 413.)

Sullivan Universal Galvanometer.—An interesting improvement in the Sullivan galvanometer *as a speaking instrument*, and one which seems to be of great practical utility, has been brought to our notice. It is well known that *retardation*, which is inseparable from very long submarine cables, and increases as the square of the length, tends to make signals "tail," and lose their individuality by the time they arrive at their destination. This has hitherto necessitated the employment of signalling condensers (or some curbing device) to compensate retardation as much as possible so as to render signals more defined and legible. By means of a modification in the suspension which regulates the control of the suspended coil, and in the electromagnetic and mechanical damping of the coil system, Mr. Sullivan has succeeded in doing away with the customary signalling condensers on even the longest cables yet laid. Reports which have been brought to our notice show that the modification in question has been tried on one of the longest cables in the world, and has proved entirely successful; while signals received under the same conditions with an ordinary *mirror speaking instrument* were quite unreadable. In view of the fact that the Admiralty already uses the Sullivan universal galvanometer on many of our ships, this new modification, whereby the auxiliary apparatus hitherto required with speaking instruments for signalling purposes has been so greatly simplified, will, without doubt, be of the utmost importance owing to the necessity of our war ships being able to communicate through long cables whenever the exigencies of warfare require it. For this purpose, simplicity of apparatus is of paramount importance, and this feature the Sullivan instrument possesses in an eminent degree. Moveover, what is so essential at times of sudden emergency and pressure, is the fact that the suspension is of such a durable nature as to be practically unbreakable through rough usage, so that as a speaking instrument it is never likely to fail at a critical moment. We have the more pleasure in congratulating Mr. Sullivan on this further success achieved with his universal galvanometer, as we were the first to point out the advantages and wide range of usefulness of the instrument.

Infringement of Copyright.—Mr. J. Slater Lewis recently sought an injunction against the Scientific Publishing Company and John Heywood, restraining the defendants from infringing the copyright of his well-known book, "The Commercial Organisation of Factories," by the publication of a work entitled "The Commercial Management of Engineering Works." Mr. Lewis, who conducted his case in person, made a three-hours' opening speech, and lost. He now asks the assistance of the technical press in drawing attention to what he considers the gross injustice which has been meted out to him. We have carefully read the full *verbatim* copy of Mr. Justice Cozens-Hardy's summing up, and we fail to see the force, or, indeed, the validity of Mr. Lewis's alleged grievances. The judgment is couched in calm, thoughtful, judicial, unbiassed, and common-sense language, and is throughout in sympathy with the plaintiff; but, to our way of thinking, the judge put the whole case in a nutshell when he said: "It is, I think, equally manifest that any two men seeking to write upon a subject of that kind, must necessarily cover to a large extent the same ground, and I cannot help thinking that Mr. Lewis has rather got in his mind *an idea that copyright* (the italics are our own) is something which is intended to protect *the ideas of an author* from being either stated or multiplied or copied, if you like, by any subsequent author, *when, in fact, copyright is merely a matter of form*." We share the judge's great sympathy with Mr. Lewis just as we agree with his decision; but we hope that in any future litigation the plaintiff will see the desirability of seeking legal aid in conducting his case, particularly in matters involving special knowledge, such as the law of copyright. To those who are in a managerial capacity in engineering works we would suggest that a perusal of both works would probably be a wise course to pursue.

Obituary.—We regret having to record the death of Sir Douglas Galton which occurred in London on the 10th inst. at the age of 77 years. Sir Douglas's name is principally known in connection with his work in Railway Engineering and Sanitary Science, in both of which fields he was a great authority. He also rendered service in the cause of submarine telegraphy. When the 1858 Atlantic cable had broken down and the Red Sea and Indian Telegraph had proved a failure, the Government being interested in the latter system, appointed a committee of inquiry with Sir Douglas as chairman to investigate the whole question. In 1861 he published a report which is described as the most valuable collection of facts, warnings and evidence ever compiled concerning submarine cables. A few years later he was a member of the consultative committee, of which Lord Kelvin is now the only survivor, which was asked to advise the Atlantic company on the electrical and mechanical questions involved in the proposed cable of 1865. Sir Douglas had been for a great number of years actively connected with numerous learned societies. In 1894 he was elected an honorary member of the Institution of Civil Engineers. He acted as general secretary of the British Association for 25 years, and at the Ipswich gathering a few years ago he occupied the position of president.

M. Secrétan died a few days ago at 63 years of age. The *Times* describes him as the chief engineer of one of the greatest and most disastrous financial speculations of modern times. In March, 1888, a movement was set on foot in Paris under his direction to raise the price of copper, which gradually developed into an attempt to control the output of that metal all over the world. The price of Chili bars was artificially raised in the course of a few months from £38 to £80 a ton, and even reached a *maximum* of £102 a ton. But the task ultimately proved too gigantic even for the powerful financial houses whose support M. Secrétan had secured. The crash came in March, 1889, when, together with the Société des Métaux, the Comptoir d'Escompte and other less important firms collapsed, and widespread financial disaster was only averted by the prompt intervention of the French Government and the Bank of France, supported by Messrs. Rothschild and other influential bankers. M. Secrétan was prosecuted for fraud, and sentenced on May 28th, 1890, to six months' imprisonment and 10,000 francs fine, other members of the copper ring receiving minor punishments. M. Secrétan's connection with the Elmore Copper Depositing process is matter of history, particularly in regard to the management of the French Company.

Personal.—We hear that Mr. W. Wyld, A.I.E.E, of Bishop Auckland, deputy electrical engineer to the county borough of Salford, has accepted the appointment of electrical engineer to the Patent Shaft and Axlectric Company, Limited, of Wednesbury, where he will have the erection and management of a large electrical power plant on the multiphase alternating system.

Appointments Vacant.—Two junior assistant engineers are wanted for the Bolton Electricity Works. The Shrewsbury Lighting Committee want an assistant engineer. The Devonport Corporation are inviting applications for the post of electrical engineer to devise, supervise, and manage an electric lighting, tramway, and power plant. The Edinburgh Corporation want an assistant superintendent of mains. See our "Official Notices" this week.

The Murphy Surface Rail System.—A special telegram from New York to the *Railway World* states that the Murphy surface rail electric tramway system has been practically tested on Manhattan Beach, Long Island, with complete success. In this system no overhead wires or open conduit are required, as the cars are supplied with current taken from a sectional rail laid flush with the surface of the roadway. The only portion of this rail which can be made electrically "alive" is the section immediately under the car, and consequently all danger is avoided. The Murphy system is far less costly than the conduit construction, and it is claimed that it can be built for the price of the overhead trolley wire system.

Our American Contemporaries.—The past ten years or so has witnessed many and varied developments in the field of electrical journalism. The changes on this side have been of less consequence than has been the case in America, where the scope of the technical press and the field to be catered for have been of considerably greater magnitude. The story of the rise and fall of the electrical journals in the States is one full of interest to those who have closely watched their progress. Journals have been introduced out of due time into an already full field, and after a brief struggle have ceased to exist, but two or three of the higher class publications have gone uninterruptedly upon the even tenor of their way and Englishmen have welcomed them as the New York mails arrived. Sometimes they might not arrive with that clockwork regularity characteristic of English electrical journals, and all good-humoured attempts to cast the onus upon the mail have at times been spoiled by a lapsing of three or four weeks. But generally speaking, the *Electrical World* and *Electrical Engineer* have borne the marks of very able management, both in regard to editorial and business departments, and the amalgamation of these two publications is the most interesting journalistic development that we have heard for many a day. From and after March 11th the two journals are to appear weekly as one publication, to be known as the *Electrical World and Electrical Engineer*, under the editorship of Mr. T. C. Martin and Mr. W. D. Weaver. It is hoped that a technical and industrial journal will be produced that will worthily represent the important field covered. Mr. W. J. Johnston, after devoting 25 years to the building up of the *Electrical World*, will retire from the field of electrical journalism. We wish our old contemporaries everything that is good under the new arrangement.

English Electrical Development in Egypt.—We understand that a concession for 20 years has been granted to Messrs. H. A. Henderson, Murdoch & Templeton, for the public and private supply of electricity to the town of Mansourah, Egypt. This is the first electrical concession granted to an English syndicate in Egypt. It is proposed to establish a three-wire system with supply at 210 or 420 volts, and later to add motor generators and a storage battery. Tenders will be invited for the supply of the whole of the necessary plant and material. Mr. H. A. Henderson, late of the Manchester Corporation Electricity Works, is the chief engineer.

Wireless Telegraphy.—It is stated that in response to the petition sent by the Dover Corporation to the Trinity House requesting that all lightships shall be connected with the shore by means of wireless telegraphy, a reply has been received. The Trinity House state that experiments are still being conducted, and that the Corporation's suggestion will be considered in due course.

Electrical Experiments in France.—A Paris journal says that experiments are being made at the Ministry of Posts and Telegraphs with a new "loud-speaking" telephone. Experiments are also being made in wireless telegraphy between Nice and Cape Corso, in Corsica, a distance of over 100 miles.

Lecture.—Before the Philosophical Society of Glasgow on 8th inst., Dr. Maclean read a paper on "Electric Methods of Space Telegraphy, and the Results of some Experiments with Hertzian Waves," prepared conjointly with Mr. Vincent J. Blyth.

Institution of Electrical Engineers.—It is stated that on Thursday next week, March 23rd, Mrs. Ayrton is to read a paper before the above Institution on "The Hissing of the Electric Arc."

Appointment.—Mr. F. Harman Lewis has been appointed electrical engineer to the Leyton District Council in place of Mr. Bishop, resigned.

Institution of Civil Engineers.—The annual dinner of the above Institution was held on Wednesday night, Mr. W. H. Preece presiding.

The Long-Schattner Prepayment Meter.—Since we described this meter several months ago, the makers have introduced an improvement of some importance. The meter is so constructed that when the amount of current has been used which corresponds with the value of the coin inserted, a dimming resistance is automatically introduced into the lamp circuit, which largely reduces the light, without altogether extinguishing it, and the current consumed during this time has to be paid for out of the next coin. It has been objected to this plan that a dishonest consumer might, by using lamps of such a voltage that they would burn well with the resistance in circuit, consume current without inserting any coins, and also that a dimming resistance, suitable when two or three lamps are alight, would be much too high for a large number. The recent improvement consists in an electro-magnetic arrangement, which inserts the dimming resistance in two sections, so that when many lamps are alight one section is short-circuited, and the resistance is less than when few lamps are alight. This plan is said to meet both the objections raised to the action of the meter.

Electric Power in Warships.—The daily press says that Mr. Assistant-Secretary Allen has decided in the negative the question whether electrical power should be used for auxiliary purposes, in preference to steam, on the new American warships. On this matter the builders were divided in opinion. Admiral Sampson, Commodores Schley, Cook, and others approved of electrical power, but Mr. Allen supports the contention of those who hold that steam is a more certain power at present for hoists, cranes, winches, steering gear, and other subsidiary purposes.

NEW COMPANIES REGISTERED.

British Pioneer Electric Light and Power Company of India, Limited (60,850).—This company was registered on February 27th, with a capital of £3,000 in £1 shares, to apply for and deal with, in the United Kingdom, India, Burmah, Ceylon, and elsewhere, any right, privilege, concession, or contract for generating, supplying, distributing, and employing electricity or other power, and to carry on the business of electricians, engineers, &c. The first subscribers (each with one share) are:—James A. Kelman, 51, Highbury New Park, N., solicitor; James A. Kelman, jun., 24, Leconfield Road, N., electrical engineer; Charles S. Kelman, 316, Winchester House, E.C., merchant; Douglas E. Kelman, 48, Artillery Lane, E.C., manufacturing chemist; Adam McIntosh, Craigella, Kelross Road, N., publisher; Edwin A. King, 49, Rylett Crescent, Shepherd's Bush, W., accountant; George C. Eedes, 85, Isledon Road, Finsbury Park, N., clerk; and Joseph Rowell, 15, The Common, Ealing, W., merchant. The first directors (to number not less than three nor more than five) are to be nominated by the subscribers; qualification, 50 shares.

Macroom and District Electric Lighting Syndicate, Limited (60,859).—This company was registered on February 27th, with a capital of £5,000 in £10 shares, to acquire the plant, machinery, cables, and concessions relating to the lighting by electricity of Macroom, in the county of Cork, to enter into an agreement with William P. Theerman, and to carry on the business of electricians, suppliers of electricity, machinists, electrical apparatus manufacturers, &c. The first subscribers (each with one share) are:—Henry Shaw, 43, Rosamond Street East, Manchester, clerk; Daniel Ashton, 368, Liverpool Street, Salford, traveller; Charles A. Clarke, 37, Marshall Place, Cheetham, Manchester, electrical agent; Lewis H. Shaw, 14, Davenport Road, Hazel Grove, near Stockport, traveller; James Johnson, 110, Manchester Road, Swinton, near Manchester, coal merchant; Joseph McDermott, Spain House, Ashton-under-Lyne, electrical engineer; and Joseph Crossley, 23, Cross Street, Manchester, chartered accountant. Registered without articles of association. Registered office, 23, Cross Street, Manchester.

Equipment Syndicate, Limited (60,922).—This company was registered on March 2nd, with a capital of £200,000 in £100 shares to construct, execute, carry out, equip, improve, work and control railways, tramways, canals, reservoirs and other public works, and to carry on the business of ironfounders, engineers, tool makers, brass founders, metal workers, boiler makers, electricians, suppliers of electricity, electrical apparatus manufacturers, &c. The first subscribers (each with one share) are:—Henry W. Gethin, 15, Chester Road, Kidderminster, accountant; George Longmore, 63, Park Lane, Kidderminster, secretary; Charles Pearson, Station Hill, Kidderminster, accountant; Henry B. Norman, Crescent Road, Kidderminster, house agent; William J. Bowdler, 39, Lorne Street, Kidderminster, typist; John L. Walters, 8, Worcester Street, Kidderminster, cashier; and George M. Perkins, Station View, Wribbenhall, Bewdley, book-keeper. The first directors (to number not less than four nor more than seven) are to be nominated by the subscribers; qualification, £500; remuneration as the company may decide. Registered office, Bank Buildings, Exchange Street Kidderminster.

Automatic Magneto-Electric Ignition Company (France and Belgium), Limited (60,925).—This company was registered on March 3rd, with a capital of £15,000 in £1 shares, to enter into an agreement with Frederick R. Simms and Robert Bosch, and to carry on the business of proprietors and manufacturers of, and dealers in, motors, motor cars, carriages, vans, waggons, and cycle parts and accessories, electricians, electrical and mechanical engineers, machinists, rubber manufacturers, &c. The subscribers (each with one share) are:—Frank K. Cheese, 19, Beechdale Road, Brixton Hill, S.W., engineer; James W. Scott, 80, Springfield Road, Tottenham, secretary; Arthur E. Heming, 19, Connaught Mansions, Battersea, secretary; Henry M. Scot, 80, Springfield Road, Tottenham, clerk; Bertram C. Joy, 118, Broadhurst Gardens, Hampstead, engineer; Antonio B. Agacio, 11, Chichester Street, S.W., secretary; Edouard E. Lefebure, 56, Greyswood Lane, Streatham Common, engineer. The first directors (to number not less than three nor more than five) are Frederick R. Simms (chairman), Robert Bosch, and C. Harrington Moore; qualification, £50; remuneration, £50 each per annum and a share in the profits.

American Automobile and Motor Company, Limited (60,882).—This company was registered on February 25th, with a capital of £80,000 in £1 shares (60,000 preference), to manufacture, sell, let on hire, and deal in motors of every description, cycles, carts, waggons, vehicles, carriages, ships, boats, launches, flying machines, &c., and to carry on the business of electricians, mechanical engineers, machinists, fitters, founders, millwrights, smiths, wire drawers, tube makers, metallurgists, rubber manufacturers, oil refiners, &c. The first subscribers are:—Frank L. Gardner, 32, Old Jewry, E.C., mine owner, 1,000 shares; Sebastian B. Schlesinger, 169, Boulevard Malesherbes, Paris, gentleman, 1,000 shares; Pelayo Soberano, 29, Avenue de la Grande Armée, Paris, gentleman, 1,000 shares; Vicomte Perrault de J. Feuillasse, 1, Boulevard Point, Bugeaud, Paris, 1,000 shares; Rene de la Ville le Roulx, 50, Avenue Morceau, Paris, gentleman, 1,000 shares; Ralph C. Aldrich, 47, Boulevard Haussmann, Paris, secretary, 1 share; and Felix C. Soul, 47, Boulevard Haussmann, Paris, secretary, 1 share. The number of directors is not to be less than three nor more than seven; the first are Frank L. Gardner, chairman, Albert Geiger, vice-chairman, Sebastian Schlesinger, Rene de la Ville le Roulx, Baron Paul de Villaine, and Pelayo Soberano; qualification, £1,000; remuneration, £500 each per annum.

Lux Syndicate, Limited (60,880).—This company was registered on February 28th, with a capital of £2,030 in £1 shares (30 founders'), to carry on the business of electricians, electrical, mechanical, civil, marine, metallurgical and chemical engineers, suppliers of electricity, lamp, glass and globe manufacturers, iron, brass, and metal founders, smiths, japanners, hardwaremen, &c. The first subscribers (each with one share) are:—Mrs. Caroline Webb, 5, Bracewell Road, North Kensington; Robert Webb, 5, Bracewell Road, North Kensington, printer; Stanley H. Mills, 39, Lancaster Road, East Ham, clerk; Charles M. Caplen, 38, Poole Road, South Hackney, accountant; Alfred J. Hardy, 21, Edric Road, New Cross, S.E., clerk; T. W. Johnstone, 126, Hornsey Park Road, Hornsey, printer; and Alfred H. Atkins, 23, Bouverie Street, E.C., registration agent. Harry Godfrey is the first director; qualification, £50.

International Telephone Manufacturing Company, Limited (60,884).—This company was registered on March 1st, with a capital of £200,000 in £1 shares, to manufacture telephones and telephone appliances; to establish, work, manage, control, and regulate telephone exchanges and electric light works; and to carry on the business of a telephone, telegraph, and electric light, heat, and power company. The first subscribers (each with one share) are:—Charles Cowley, Brocklands, Ches., secretary; Arthur E. Cowley, Thornfield, Priory Road, Sale, Ches., secretary; H. D. J. Claxton, 90, Claremont Road, Alexandra Park, Manchester, accountant; Charles E. Craig, 12, St. Bees Street, Manchester, book-keeper; John D. Haddock, 88, Broughton Lane, Manchester, secretary; James H. Todd, Examiner Buildings, Manchester, advertising contractor; William H. Sinclair, 8, Ducie Street, Oxford Road, Manchester, secretary. The first directors (to number not less than three no more than seven) are to nominated by the subscribers; qualification, £200; remuneration, £250 each per annum, and £350 for the chairman.

Traction Development Company, Limited (60,961).—This company was registered on March 4th, with a capital of £40,000 in £1 shares, to enter into an agreement with the "Gas Traction Company, Limited," for the acquisition of exclusive rights in connection with the patents of that company in France, Spain, Portugal, Turkey and Egypt, to supply motive or mechanical power, including gas, electricity, air, &c., and to manufacture, sell and deal in carriages, motor cars, trucks, vehicles, accumulators, dynamos, &c. The first subscribers (each with one share) are:—A. P. Ibbots, 25, Austin Friars, E.C., secretary; A. Auer, 9, Throgmorton Avenue, E.C., clerk; A. E. Taylor, 5, Parkside Villas, Wood Green, N., accountant; H. J. Ashton, 5, Devonshire Road, Leytonstone, clerk; J. D. Batson, 9, Throgmorton Avenue, E.C., clerk; Sidney Nicholl, 25, Austin Friars, E.C., clerk; and H. A. Allison, Clovelly, Hampton Hill, S.W., chartered accountant. The first directors (to number not less than two nor more than seven) are to be nominated by the subscribers; the Gas Traction Company, Limited, can nominate one director; qualification, 200 shares; remuneration, £200 each per annum.

Freshwater and Totland (I.W.) Electricity Supply Company, Limited (61,069).—This company was registered on March 11th, with a capital of £15,000 in £1 shares, to form centres at Freshwater and Totland, in the Isle of Wight, and elsewhere, for the generation of electric light and power, and to carry on the business of electricians, electrical and mechanical engineers, and manu-

facturers of lightning conductors, electrical generators or accumulators, lamps, fittings, &c. The first subscribers (each with one share) are:—William S. Nicholson, J.P., Eastmore, Yarmouth, I.W.; R. G. Temple-Cotton, Matin Cottage, Freshwater, I.W., Lieut.-Col.; Alfred Bayliffe, Chine Cliffe, Totland Bay, I.W., gentleman; Alfred Hollins, M.D., Freshwater Bay, I.W.; C. H. Hands, M.B., B.A., Oxon., Totland Bay, I.W.; John Dover, Sunny Bank, Totland Bay, I.W., gentleman; and William J. Waterhouse, estate office, Totland Bay, I.W., house agent. The first directors (to number not less than three no more than five) are William S. Nicholson, R. G. Temple-Cotton, and Alfred Bayliffe; qualification, 50 shares.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Potteries Electric Traction Company, Limited (57,968).—This company's statutory return was filed on February 3rd, when seven shares were taken up out of a capital of £400,000 in £10 shares. No calls have been made.

Pacific and European Telegraph Company, Limited (36,683).—This company's annual return was filed on December 29th, when the capital of £100,000 in £10 shares was fully subscribed; £4 per share has been called and £40,000 paid.

Ryde Electric Light and Power Company, Limited (53,086).—This company's annual return was filed on January 17th, when 7 shares were taken up out of a capital of £10,000 in £5 shares on which no calls had been made.

Portable Electric Lamp Company, Limited (45,052).—This company's annual return was filed on February 16th, when 40,157 shares were taken up out of a capital of £50,000 in £1 shares, 40,000 shares are considered as fully paid, and £157 has been paid on the others.

St. James's and Pall Mall Electric Light Company, Limited (26,015).—This company's annual return was filed on March 6th. The capital is £300,100 in 40,000 ordinary and 20,000 preference shares of £5 each and 100 founders' shares of £1 each. 31,980 ordinary and 20,000 preference and 100 founders' shares have been taken up, the full amount has been called and £260,000 paid.

Eastern Telegraph Company, Limited (6,338 C).—This company's annual return was filed on March 8th. The capital is £6,000,000 stock, of which £5,795,263 has been taken up and paid for in full.

Amazon Telegraph Company, Limited (44,532).—This company's annual return was filed on February 15th, when the capital of £250,000 in £10 shares was taken up and fully paid.

National Electric Supply Company, Limited (29,992).—This company's annual return was filed on March 1st. The capital is £84,943 15s, in 9,050 preference shares of £5 each, and 10,850 ordinary and 100 founders' shares of £3 12s. 6d. each. 1,000 preference and all the others have been taken up, the full amount has been called, and £44,693 15s. received.

Newcastle and District Electric Lighting Company, Limited (28,022).—This company's annual return was filed on March 9th, when 9,918 shares were taken up out of a capital of £100,000 in £10 shares; £8 per share has been called on 5,000 and £5 per share on 4,918, resulting in the receipt of £65,457, including £867 paid in advance of calls.

Westminster Electric Supply Corporation, Limited (27,061).—This company's annual return was filed on March 9th, when the whole capital of £399,500 in £5 shares was taken up and paid for in full.

CITY NOTES.

House-to-House Electric Supply Company, Limited.

The eleventh ordinary general meeting of the above company was held at Winchester House on Thursday last week, Mr. William Page in the chair.

In moving the adoption of the report, the Chairman said he had been asked to preside in the absence of Mr. Beeton, the chairman, but he need not detain them very long, as there was nothing very special to mention beyond what was referred to in the report. He would first remind them that the chairman at the last meeting drew their attention to the satisfactory features of the development of the company's business during the last few years especially. He mentioned the increase of the company's business which had been so steadily progressive, and also to the continued decrease in the cost of the output, which was a very satisfactory feature, and he mentioned that to obtain the results which had been secured it had been necessary to substitute new plant, and thus antiquate a certain portion of their plant, and he also explained how that affected their capital to a certain extent, though what was lost in that way had been probably more than counterbalanced by the increased value of the goodwill of the company. He also drew their attention to the fact that a system had been initiated by the company of free wiring, which consisted of undertaking the wiring of houses for a certain number of lamps free of all charge and without enhancing the cost of the current supplied to them. He also explained that these various things were greatly due to the energy of their manager and engineer, Mr. Bowden. All the points mentioned by the chairman at the last meeting held good that day, and, further, he was able to announce that they proposed an increased dividend from 4 per cent. for 1897 to 6 per cent. for that year. The development of the business since the end of the year had continued equally satisfactory, and new customers were continually coming in. They compared most favourably with the other eight companies of London with regard to cost of working. Of the eight companies they had the smallest output, for they had the smallest area, but their works' cost stood second with the Westminster Company, the St. James's Company, which had the cream of the areas in London, taking first place. They were a long way below the other companies in works' costs, being equal with the Westminster Company, although the output of that company was five times as much as their own. Their total working expenses worked out at 43½ per cent per annum, so that the profits were really 56½ per cent. per annum. In the report details were given of the gradual increase in the business of the company from the beginning, and they would see that the gross receipts had now reached £24,906 and the total expenditure £10,840, leaving the net receipts at £14,066, which he trusted the shareholders would deem satisfactory. He had mentioned the free wiring system, and he might say that a large proportion of the new business they were getting was due to that system. Many people otherwise would not have electricity in their houses because of the initial cost of wiring the houses. In many cases they were only tenants, and did not like to incur the cost, but as soon as they initiated the free wiring system the number of customers increased at once. All that necessitated continual preparation for further business, and during the year they had completed a large boiler house, and they had plant almost continually on order, as it took a long time to get the plant they wanted. They had now two units of plant in the present year, and their station was about large enough to take in probably about 2,000 H.P., which was about enough to double their present output, so that they had no need to look about for a fresh station yet. They had been negotiating with the Kensington local authorities with a view to public street lighting, and were fixing up half a dozen street lamps, and would supply them with current free for 12 months, and that might lead to a considerable amount of business in the future. The cost of production that year had been slightly higher, although the efficiency of their plant was higher, but coal had been dearer, and rates and other things higher. Nothing was said in the report about the Construction Company whose business went into liquidation two years ago, and they had not been able to hear anything satisfactory about it; at all events, they had got no money.

Mr. W. F. Leese seconded the motion, and the report was adopted without discussion.

Hove Electric Lighting Company.

The seventh annual general meeting of the shareholders of the above company was held on Wednesday last week at the Cannon Street Hotel, Col. A. J. Felgate presiding.

In moving the adoption of the report, the Chairman said it gave the board very great satisfaction to be able to meet the shareholders with such an excellent report, and to make the position clear to them, he would say a few words on the figures before them. As was stated in the report, the capital expenditure during the year was £10,641, increasing the total outlay at the end of the year to £77,450 12s. 2d. They had placed a new 350-horse-power Willans-Crompton set in the works, and also a 40-H.P. Willans-Crompton set, the latter set having been acquired with a view to economical working when a light load only was necessary. This involved a capital outlay of £3,566, and had increased the power of their generating plant to 1,090 H.P. They had also put up an additional Babcock and Wilcox boiler, at a cost, including steam pipes, valves, &c., of £1,051, and had added 2½ miles of new mains to the system, increasing the length of mains to 14½ miles. These extensions had cost £4,550, and they had also expended £1,120 on new meters and demand indicators, and £215 in the sinking of a well 190 feet deep in the works, which enabled them to get a supply of water at an economical cost. The money, he believed, had been well spent. As was stated in the report, the further increase of the business necessitated the spending of further capital, and they had ordered two additional Willans-Crompton sets of 350-H.P. and 250-H.P. for delivery next summer, and also another Babcock & Wilcox boiler. This necessitated the extension of the lighting station, and they had entered into a contract for carrying that out. It was also found necessary to construct a new feeder from the works to Church Road, and to strengthen the feeders at other points. They had further sanctioned some new mains, and would no doubt have to still further extend them in the near future. To meet this capital outlay they had issued 1,000 of the new shares sanctioned at the last meeting at a £2 premium, and they had just issued a further 1,000 at £2 10s. premium, all of which had been taken up and allotted. That, however, would be insufficient to meet their requirements, as the undertaking showed signs of expanding to considerable dimensions, and so they considered it desirable to ask the shareholders to agree to the capital being increased from £50,000 to £100,000, the new capital to be issued at such times and on such terms and conditions as might from time to time be found desirable. The number of their customers had increased from 270 at the end of 1895 to 314 at the end of 1896, to 397 at the end of 1897, and to 513 at the end of 1898. The number of 8-candle-power lamps attached to the system at the same dates were the equivalent of 18,298, 21,914, 27,777, and 36,967. The number of units delivered to the customers in the four years were: 1895, 162,428; 1896, 200,562;

1897, 268,243, and in 1898, 350,354. The gross revenue for the year was £9,480, or £2,210 in excess of that of 1897, and the net revenue had been £5 089, or an increase of £1,486. Their revenue from current supplied to customers amounted to less than the low figure of 5s. 1½d. per 8-C.P. lamp per annum. They would pay a dividend of 8 per cent. for the year. Dealing with the explosion which occurred at Church Road in January, the chairman said that the company had been found to be free from blame by the Board of Trade.

Colonel Wood seconded the motion, and it was carried.

Subsequently a resolution was passed increasing the capital of the company by the issue of 10,000 additional shares of £5 each to rank *pari passu* with the existing shares.

Buenos Ayres and Belgrano Electric Tramways Company, Limited.

The report for 1898 states that the revenue account comprises the receipts and expenses of the old horse lines in Buenos Ayres from March 1st, 1898, when the old lines were taken over, to December 31st, 1898, and also includes the receipts and payments on the short section of about 2¼ miles of new electric line taken over by this company on June 22nd, 1898. The total receipts amounted to £57,337, and the expenses to £41,392, showing a profit for 10 months of £15,945. The debenture interest has absorbed £9,920, and the directors recommend a dividend at the rate of 6 per cent. per annum on the amounts paid on the "A" preference shares. This will amount to 1s. 6½d. per share, and will absorb £3,083, leaving a balance of £2,844 to be carried forward. The directors deem it advisable to keep this balance in hand, in view of the fact that there is a claim pending in connection with a contract, of which the directors, however, hope to obtain a reduction. The increase in sterling receipts is partly due to the increase in the traffics and partly to the fall in the gold premium, the average premium in 1898 being 157, as compared with 193 in 1897

Direct Spanish Telegraph Company.

The report and accounts of the directors for the year ended December 31st, 1898, to be presented at the yearly general meeting of shareholders, to be held on Friday, March 17th, 1899, states that the accounts for the year ended December 31st, 1898, show, after providing for interest on, and redemption of, debentures, a balance to the credit of revenue of £11,843 18s. 9d. After adding the usual sum of £5,000 to the reserve fund, the balance will amount to £6,843 18s. 9d., and the directors recommend the declaration of dividends for the year 1898, of 10 per cent. on the preference shares, and 4 per cent. free of income-tax, on the ordinary shares, absorbing £5,486 4s. Half of this amount was distributed on October 1st, 1898, as an interim dividend in respect of the half-year ended June 30th, 1898. A balance of £1,357 14s. 9d. will remain, and the directors, in view of fluctuations of traffic, &c, consider it advisable to transfer this amount to the contingencies account. The traffic receipts show an increase of £3,812 15s. 5d., as compared with the year 1897. The ordinary working expenses are £349 3s. 8d. in excess of those for the year 1897. On May 21st, 1898, a fault was discovered in the Bilbao cable at about 13 knots from Bilbao. Although this fault did not interfere with the communication it was thought prudent to remove it, and this was effectually done on June 23rd, 1898. On July 8th, 1898, the Bilbao cable broke at a distance of 199 knots from Falmouth, but was repaired on July 14th, 1898. In both cases the repairs were promptly executed by cable ships of the Eastern Telegraph Company. The costs of these repairs, viz, £2,117 11s. 3d, is charged to the revenue account for the year. The premises occupied by the company at 74, Gracechurch Street, as their head telegraph office in London, had been found for some time past to be totally inadequate for the requirements of the service, and the directors therefore seized the opportunity of leasing the house next door, and they are glad to say that full accommodation is now provided for the company's business and staff. They have succeeded in letting the portions of the premises not required by the company on advantageous terms. The cost of fitting these premises for the company's purposes, viz, £961 5s. 3d., is also charged in the revenue account. Mr. J. Denison Pender is the director retiring by rotation, and offers himself for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., retire, and offer themselves for re-election.

Metropolitan Electric Supply Company.

The twelfth ordinary general meeting of the shareholders of the Metropolitan Electric Supply Company was held on Tuesday last at Winchester House, E.C., Sir James Pender, M.P., presiding.

The Chairman said: I desire, in the first place, to express my regret that, owing to the serious illness through which our chairman, Sir Eyre Shaw, has passed, he is not present to-day, and it has therefore devolved upon me to preside on this occasion. I feel sure that Sir Eyre Shaw will receive the sympathy of all the shareholders, and that you will give me that support which you have so readily accorded to the chair in the past. Since we last met we have to deplore the loss of Dr. John Hopkinson, who, as one of our consulting engineers from the inception of the company, rendered us the greatest help in all the many technical questions upon which he was called upon to advise. The report and accounts fully show the company's position during the period with which we are dealing; but I will endeavour to explain them in greater detail in the remarks which I have now the pleasure of making. Turning in the first instance to the capital account, you will observe that our capital has been increased by the issue of 22,500 shares. Many shareholders have written to us in reference to this issue, but I think you will readily call to mind that these shares were subscribed for at par by the holders of founders' shares in consideration of the rights of those shares having been cancelled. This arrangement was carried out in accordance with the resolutions passed by you at an extraordinary general meeting on June 7th last. I may take this opportunity also of explaining that the shares Nos. 1 to 100, which were formerly founders' shares of the nominal value of £10 each, now rank as ordinary shares of like value, but without any special privileges attaching thereto. The additional capital thus issued, and upon which up to the end of the year £118,530 had been paid, has been almost entirely expended on mains and on our new Willesden works. With regard to our works at Willesden, you will have observed from the report that an Act was obtained during the last session of Parliament authorising us to erect these works, and this Act also gave us power to lay our mains along the tow path of the Grand Junction Canal Company, we having previously entered into an agreement with that body for that purpose. At one time we hoped that it might have been possible to have had the assistance of these works to relieve the strain of the past winter's supply. This, however, it was not practicable to effect, and we have no doubt in the long run that it will be found advantageous not to have been tempted to unduly press forward these works, for ample time will now be available for perfecting this important undertaking, as we are now aiming for the completion of the first portion in the early part of the summer, in order that the plant may be in thorough working order to cope with next winter's demand. With regard to our expenditure on mains, this, in addition to our normal extensions, has been largely caused by the change we are gradually making in our system of supply. The unfortunate fire which occurred at our Manchester Square works in the summer considerably delayed us in this work, the necessity for which, from the point of view of economical working and distribution has already been explained to you, and is becoming increasingly urgent. The only other item in our capital expenditure, to which I think it is necessary to allude, is the heavy item of Parliamentary expenses. A portion of this expenditure was entailed in connection with our Willesden Act, and the remainder through our having been forced to defend, and I am glad to say successfully defend, our property in Marylebone. To this I shall refer again. We will now turn to the revenue account, and here you will see that we have had a very considerable increase of business, an increase which is not altogether shown by the growth of revenue receipts. This is accounted for by the large reductions we found it necessary, as a matter of policy, to make in our rates of charge to customers. In addition to the desirability of conciliating local authorities, we had to meet actual competition in some districts, and to provide for a contingency of possible competition in others before the alteration in our system of distribution and the completion of our new generating works had placed us in a position to make this reduction profitably. This is putting in a nutshell the principal reason of the reduction in the dividend which it has been found practicable to recommend. This is also the principal explanation of the increased proportion of revenue expenditure to gross income, although the fire at Manchester Square, to which I have already referred, involving as it did large purchases of current from other companies, and the serious trouble brought about by the Welsh coal strike, have also had an important share in the increase of expenditure. The coal strike was a serious matter, as it not only entailed the use during its continuance of unsuitable and expensive fuel, but it has left behind it a legacy of increased prices, which we fear will be maintained for some time to come. I ought to take this opportunity of expressing our thanks for the assistance rendered to us by other supply companies, by which we were enabled to supplement our own supply during the exceptional period under review. With regard to this coal expenditure, the amount of which is such a serious factor in our working, I can assure you that the board are fully alive to the absolute importance of effecting every possible economy in this direction. It is wholly in view of this necessity that our original system of distribution, admirably adapted as it was for pioneering work over a large district like ours, but unsuitable after the business has developed, and the demand has become general, is being changed as speedily as circumstances will admit. These changes, coupled with the decreased works' cost, which we may hope to attain at Willesden, will, the board are confident, ultimately have the effect of placing the company in a position to cope profitably with any requirements which may arise. The changes I have indicated, and the completion of our works, all point to the necessity of further capital issues. It will be seen from the accounts that we have funds in hand sufficient for immediate requirements, but it will probably be found necessary to make some further issue of capital during the year; and the board, happily now unhampered by the special interests of different classes of shareholders, will be able to take such measures as will best serve the interests of the company as a whole. You will observe that the number of lamps connected during last year is a larger one than in any previous report. No doubt this is accounted for in a great measure by the reductions we have made in our rates of charge, but quite apart from this, there is no doubt that the use of electric energy is becoming yearly more general and more a necessity. It is now my pleasing duty to refer in a few words to the work of our staff during a time of exceptional strain and difficulty; for with this very large increase of lamp connection and without the hoped-for assistance from Willesden, some of our works were severely taxed, and we ought to acknowledge the skill, care, and vigilance of our officers in successfully coping with this exceptional state of affairs. We should have preferred to have been in a position to recommend at least a similar dividend to that of last year, but as, in addition to the reasons which I have given, the board are in agreement with your auditors that it

is necessary to build up the nucleus of a strong depreciation and reserve fund, they have not felt justified in exceeding their present recommendation. They are, however, fully confident in the soundness of the company's position, and look forward to the time when the rate of dividend paid last year will not only be again reached but exceeded. In conclusion, I should like to say a few words respecting the stiff fight which we had in Parliament last session to protect our property against the application made by the Marylebone Vestry to obtain competitive powers of supply against us. I scarcely like from this position to criticise too closely the unfortunate and mistaken policy which that Vestry has adopted towards this company. While freely admitting that their action was dictated by a desire to serve the interests of the ratepayers, of which it should not be forgotten that we are numbered amongst the largest, we rejoice that Parliament has decided to protect the interest of investors against what we consider to have been a most dangerous attack upon the security of capital. I trust that this policy will in future be respected as a precedent, and I shall certainly do my best to uphold it. With these few remarks I now beg to move:—"That the report and accounts for the year ended December 31st, 1898, presented to this meeting be and are hereby approved and adopted, and that in addition to the interim dividend of 5s. per share paid on September 23rd, 1898, a further dividend of 5s. per share on shares numbered from 1 to 62,500, and of 8½ per share on shares numbered from 62,501 to 85,000, be and the same are hereby declared, such dividends to be payable on March 15th, 1899, to all holders who were on the company's registers on March 4th, 1899."

Lord John Hay seconded the motion, which, after some discussion, was agreed to.

The retiring directors having been re-elected, a vote of thanks to the chairman and directors and to the staff concluded the proceedings.

Isle of Man Tramways and Electric Power Company.

The report of the Isle of Man Tramways and Electric Power Company, Limited, relating to the general undertaking, states that the amount available for dividend is £11,506. The directors recommend the payment of a dividend of 6 per cent. on the preference and ordinary shares, which will absorb £9,900. They propose to carry forward £1,000 to reserve fund, and to transfer the remainder to the profit and loss account. The company has acquired valuable water rights, which will be used for generating electricity and other purposes requiring power. An expert has reported that by these means 500 horse-power can be constantly obtained for eight months of the year, and the directors are further advised that by harnessing this power, they will be able to generate and accumulate sufficient electricity to work electric and cable systems, and do whatever lighting may be required. This will effect a considerable saving, as the steam plant will be shut down for eight months in the year. Other arrangements are being entered into, which are expected to largely increase passenger and mineral traffic. The report of the Laxey and Ramsey section of the company announces a profit of £72, which it is proposed to carry to the profit and loss account.

The Dover Electricity Supply Company, Limited.

The directors' report states that further capital expenditure, amounting to £7,714 1s. 9d., has been incurred during the year in order to meet increased demand for current by the installation of additional plant and mains. The result of the year's trading shows that steady progress has been made, the gross profit of £1,127 17s. 5d. earned in 1897 having been increased to £2,133 7s. 11d., after setting aside a sum for the formation of a depreciation reserve. A still more favourable result would have been shown but for the increased cost of fuel, arising out of the Welsh coal strike. It will be seen that the gross profit is more than absorbed by interest charges, but the directors have pleasure in stating that by the issue of the balance of the ordinary share capital arrangements have been made to pay off the loans on which the larger part of these interest charges arise. The profits of the current year will thus, after meeting debenture interest, be available for the payment of dividend to the shareholders. During the year applications have been received for the equivalent of 2,407 8-C.P. lamps, thus increasing the connections at December 31st to approximately 12,500 lamps, exclusive of the supply of power to the Corporation tramways, which now reaches a maximum of 250 H.P. daily. A contract has been entered into for the supply of current for a term of years, for both lighting and power, to the contractors for the National Harbour Works. The demand for current for the Corporation Electric Tramways is steadily increasing, and the service gives general satisfaction. On July 1st last a modification of the company's tariff was introduced, based on a maximum of 7d. per unit for a period of 1½ hours per day, and 3d. per unit thereafter. This reduction has given general satisfaction, and is resulting in a steady accession of business.

The British Electric Traction Company, Limited.

The report to be presented to the shareholders at the third ordinary general meeting of the company, to be held at Donington House, Norfolk Street, Strand, London, W.C., on Saturday, March 18th, 1899, states that during the past year the directors have issued 10,000 6 per cent. cumulative preference shares of £10 each at £12 10s. per share, and £100,000 debenture stock at £116 per cent. The whole of the premiums (after deducting expenses), amounting to £29,135 15s. 8d., have been placed to a reserve fund, and this amount has, since the close of the year, been invested in consols. Since the closing of the books further issues have been made of 20,000 preference shares and £100,000 debenture stock. The proceeds of these issue will be brought into the next account. The subscribed share and debenture capital is now—

£300,000	in ordinary shares of £10 each;
300,000	in 6 per cent. cumulative preference shares of £10 each;
200,000	5 per cent. perpetual debenture stock.
£800,000	

The whole of the present authorised share capital of the company having been subscribed, the directors recommend that powers be taken to increase the nominal capital of the company by the creation of 60,000 shares of £10 each; and notice is given herewith of an extraordinary general meeting of the shareholders to consider, and, if deemed advisable, to pass the necessary resolutions. The gross profits, including £9,804 9s. 6d. brought forward from last year, but without taking into account the aforesaid premiums of £29,135 15s. 8d., amount to £77,999 14s. 7d., and, after deducting the proportion of general expenses chargeable to revenue, and also the expenses incurred in connection with schemes not proceeded with and written off, and interest on debenture stock, there remains a net profit of £67,778 13s, which the directors propose should be applied as follows:—

Remaining portion of preliminary expenses written off	£5,879	1	8
Reduction of goodwill account	5,000	0	0
Interim dividend at the rate of 6 per cent. per annum, paid on preference shares to August 15th, 1898	1,195	15	8
Dividend at the rate of 6 per cent. per annum on preference shares, due February 15th, 1899, accrued to December 31st, 1898	2,252	1	0
Dividend at the rate of 6 per cent. on the ordinary shares for the past year	18,000	0	0
Carry forward to next account	35 451	13	8
	£67,778	13	0

Arrangements have been made for the adoption of electric traction in various localities. In some cases agreements have been entered into for the purchase or leasing of existing tramway undertakings, while in others, Parliamentary powers or orders under the Light Railways Act have been secured or applied for. Some of these arrangements have been made in co-operation with other parties. The total amount expended on works, and in negotiations and promotions (after deducting the costs of undertakings which have been sold or transferred, and after writing off expenses incurred in respect of schemes or contracts not proceeded with) is £157,730 17s. 7d. These matters are more particularly referred to in an appendix to this report, which we hope to publish next week. The company holds shares and debentures (which cost £420,731 2s. 11d.) in a large number of existing tramway and analogous companies, and in some instances the majority of shares, with a view to the further development of the company's business, and the adoption of electric traction. Particulars of most of these associated companies are given in the appendix. An income of £11,853 15s. 10d. has been derived from investments, but a large proportion of the amount appearing under this head in the balance-sheet was not so employed until the latter part of the year. In order to include the results of the working and the accounts of the associated companies, which are generally made up to December 31st, in the annual report and accounts of the company, the directors propose that, in future the accounts of the company should be made up to March 31st in each year, and that the annual meeting should be held as soon thereafter as possible. The directors who retire this year are the Right Hon. Lord Rathmore and Mr. John Smith Rayworth, and both are eligible for re-election. Mr. Frederick W. Smith, F.C.A., retires and is eligible for re-election.

Bournemouth and Poole Electricity Supply Company, Limited.

Mr Aymor H. Sanderson, chairman, presided over the second ordinary general meeting of the above company held at Winchester House on Monday, and, in moving the adoption of the report, said the pleasure the directors had in meeting the shareholders was enhanced by the fact that the results had been better than they anticipated by the prospectus of the company. With regard to their balance-sheet, their assets were represented by investments of £4,000 in 2¾ per cent. Government stock, and also an investment of £51,108 10s. 2d. in Bournemouth and District Electric Light Company ordinary shares. They had also loans to that company amounting to £63,891 9s. 10d. In all the amount invested in that company amounted to £119,000. The premiums on the first issue of shares had been applied towards writing off the preliminary expenses and it simply left a balance of £18 10s. 4d., which had been written off out of the revenue of the year. The only expenditure made by the company on capital account during the past year had been the expense of applying to the Board of Trade for provisional orders for the districts of Christchurch, Pokesdown and neighbourhood. That would include a rapidly increasing area, which in the future they considered would be a most valuable asset to the company. The only other item on that side of the balance-sheet was £4,430, sundry debtors. It consisted mainly of interest and commission due to December 31st, 1898, to that company from the Bournemouth and District Company, and that had now been very considerably reduced. On the other hand, they had their authorised capital

of £150,000, of which £30,000 was yet unissued. With regard to the revenue account, the total receipts were £6,103 9s. 5d. and after deducting their expenses of about £91, they had carried forward a balance of £6,013 4s. 10d. to net revenue account. They had paid a dividend at the rate of 4½ per cent. on the preference shares to June 31st, 1898, amounting to £1,239 15s., and also a final dividend on the shares, which left £3,469 available for distribution now, and the directors recommended that a dividend at the rate of 4 per cent. on the ordinary shares be now declared, which would absorb £2,262, and leave a balance of £1,206 9s. 10d. to be carried forward to the next account. In the opinion of the directors they held a very valuable property, for they now possessed the whole of the capital of the Bournemouth and District Electric Supply Company. As an illustration of the progress made by that company, he might mention that during the past year there had been an equivalent of 8,752 8-candle-power lamps applied for as compared with 3,482 in 1897. Taese were record figures in the history of the company, although it was, perhaps, too much to hope they could continue to make such a record of progress every year. There was an application now before the Board of Trade for the transfer of the undertaking now held by the Bournemouth and District Company to their company, and as they held the whole of the shares, there would appear to be no opposition to the transfer. If the transfer took place, it would considerably decrease the amount of their administration expenses.

Mr. Hosker seconded the motion for the adoption of the report, and remarked that the electric light had greatly grown in popularity at Bournemouth. In 1897 they had 3,482 8-candle lamps applied for, and last year they had 8,752 8-candle lamps. The districts of Christchurch, Pokesdown, and Winton, for which they were applying for a provisional order, were closely populated, and should be most valuable. Mr. Hosker also spoke in high terms of the services of the managing engineer, the secretary, and the local secretary.

Mr. Aldrich asked whether there was any likelihood of any application now before the Board of Trade overriding the present rights of the company.

The Chairman said the Bournemouth Company had done a great deal of work in the district, and for a long time worked without a profit, and judging from the mode in which the Board of Trade had acted in all other applications which had been made, he did not think that they need fear that the Board would do anything unreasonable or inequitable.

The report was then adopted.

Subsequently it was agreed to remunerate the directors at the rate of £300 per annum, to be increased to £500 if the Bournemouth and District Electric Supply Company was taken over during the year.

British Insulated Wire Company, Limited.

We have received the following account of the third ordinary general meeting of this company, held at the works, Prescot, on Wednesday, Mr. W. Marriner Brigg, chairman, presiding.

The Chairman congratulated the shareholders on the substantial progress which the company had made. Orders continued to come in very satisfactorily, and they were now in the position that in the middle of the third month of the year they had sufficient orders in hand to occupy their works for the whole year provided their total output did not exceed that of the past year, though that was not at all likely. They had every reason to look forward to a still more successful future. They had found it desirable to go in for a still further extension of their works, and that extension was already commenced. They had also arranged for a quotation of the company's shares on the London and Manchester Stock Exchanges. They had from time to time written off considerable amounts, aggregating some £70,000, as against depreciation, and in every way the company was in an excellent position.

Mr. Ebenezer Leigh seconded the motion, which was unanimously adopted.

Mr. F. Smith, of Prescot, moved that, in accordance with the directors' proposal, a further dividend of 10 per cent. on the ordinary shares, making 15 per cent. for the year, be declared.

Mr. C. P. Sparks seconded, and the motion was unanimously agreed to.

Messrs. J. E. Pearson and Thos. Snape were re-elected directors, and Messrs. Chalmers & Wade were unanimously re-elected auditors.

A vote of thanks to the chairman was carried with acclamation.

Official Announcements re Companies.

Notice is given in the *London Gazette* for 10th inst. to the effect that names of various companies, including the following, will be struck off the register within three months unless cause is shown to the contrary:—

Akester Electric-Motor and Accumulator Company, Limited.
Anders's Telephone Company, Limited.
Denison Auto-Telegraph Machine Syndicate, Limited.
Economic Electrical Specialty Company, Limited.
Electrical Plant, Limited.
Globe Electric Company, Limited.
Hermite British Electro-Bleaching Company, Limited.
Lineff Electric Traction and Lighting Syndicate, Limited.
Mexican Gas and Electric Light Company, Limited.
New Electricity Supply Company of Croydon, Limited.
Omnibus and Tramcar Electric Lighting Company, Limited.
Phœbus Electric Battery Syndicate, Limited.
Rogers Arc Lamp Company, Limited.
Self-Generating Electric Vehicle Light Syndicate, Limited.
Tayler-Smith Electric Company, Limited.

Prospectus.

In another part of this issue will be found a prospectus of Messrs. W. J. Glover & Co. (established 1818), Limited. The nominal share capital is £100,000 in £40,000 5 per cent. preference and £60,000 ordinary shares. The present issue is for £40,000 preference and £45,000 ordinary shares (£1). The company will combine the manufacture of wire drawing, rubber and insulating material, and electric cable making, and will take over the properties of Messrs. W. J. Glover & Co.'s business at St. Helens. The services of Mr. G. E. Heyl-Dia, managing director, have been retained for a term of five years. The net average profits for the past ten years have been £1,847, while for a half-year in 1898 they were at the rate of £3,400 per annum. Works for the electrical and rubber departments of the business have been acquired at Warrington. With the amount of the present issue it is proposed to extend the present wire-drawing and rope-making business at St. Helens, and to equip the large factory acquired at Warrington. The company claims that it will be in the unique position of being able to manufacture electric cables direct from the raw material, saving intermediate profits. The vendors take £52,000 (£17,000 in cash and £35,000 ordinary shares). The list closes on Wednesday next.

Rockhampton Gas and Coke Company.—The report of this company for the half-year ended December 31st, 1898, shows that the gas operations have made a profit of £2,111 and the electrical operations £286. The company has just received the sanction of His Excellency the Governor in Council for powers for electric lighting at Rockhampton for the full term of 42 years. The company's position in connection with the supply of electricity for Rockhampton and its suburbs being thus assured, the directors intend issuing debentures on the London market. The revenue account (electrical) shows fittings, current sold, professional services, £50, and rental on fittings £28 odd = £1,012, this leaving a balance of £286, which has been carried to net revenue account.

County of London and Brush Provincial Electric Company.—The directors of this company have decided to recommend payment of a dividend on the preference shares at the rate of 6 per cent. per annum, less income-tax, for the six months ended December 31st, 1898, carrying forward £5,774, subject to confirmation at the annual general meeting to be held on 27th inst.

Bournemouth and District Electric Supply Company.—A meeting of the above company was held at the offices of the County of London and Brush Provincial Company, Moorgate Court, on Monday. A representative of the Electrical Review, who attended to report the proceedings, was informed that the meeting was private.

F. H. Royce & Co.—A prospectus has been before the public this week inviting applications for an issue of 6,000 £5 preference shares (6 per cent. cumulative) in F. H. Royce & Co., Limited, electrical and mechanical engineers, of Hulme, Manchester.

Royal Electric Company of Montreal.—A quarterly dividend of 2 per cent, at the rate of 8 per cent. per annum, has been declared.

City and South London Railway Company.—Letters of allotment for the issue of £375,000 ordinary share capital have been posted.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending March 11th, 1899, were £212 9s. 6d.; aggregate to date, £1,676 8s. 5d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending March 10th, 1899, were £2,495 15s.; corresponding period, 1898, £2,259 18s. 2d.; increase, £200 1s. 10d.

The City and South London Railway Company.—The receipts for the week ending March 12th, 1899, were £1,072; week ending March 13th, 1898, £1,077; decrease, £5; total receipts for half-year, 1899, £12,179; corresponding period, 1898, £11,796; increase, £383. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending March 11th, 1899, were £147 4s. 7d.; week ending March 12th, 1898, £100 5s. 9d.; increase, £46 18s. 10d. Total receipts to date, 1899, £1,480 1s. 3d.; corresponding period, 1898, £1,048 11s. 6d.; increase, £381 9s. 9d. Miles of track open week ending March 11th, 1899, 8; week ending March 12th, 1898, 8. Car miles run week ending March 11th, 1899, 4,814; week ending March 12th, 1898, 3,051. Number of cars, week ending March 11th, 1899, 11; week ending March 12th, 1898, 7.

The Dublin United Tramways Company.—The receipts for the week ending Friday, March 10th, 1899, were as follows:—D. U. T. Co., horse cars, £1,682 11s. 8d.; ditto, electric cars, £980 8s. 9d.; D. S. D. Co., electric cars, £625 12s. 9d.; total, £3,188 13s. 2d.; corresponding week last year—D. U. T. Co., horse cars, £2 847 4s. 10d.; ditto, electric cars, £111 15s. 8d.; D. S. D. Co., electric cars, £378 10s.; total, £2,887 10s. 6d.; increase, £351 2s. 8d.; aggregate to date, £31,724 0s. 11d.; ditto last year, £30,202 0s. 9d.; increase to date, £1,522 0s. 2d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways. — The receipts for the week ending March 8th, 1899, were £301; total receipts to date, March 8th, 1899, £9,729. Miles of track open, 8½. Car miles run, 5,356. Number of cars, 10.

The Liverpool Overhead Railway Company.—The receipts for the week ending March 12th, 1899, amounted to £1,364; corresponding week last year, £1,330; increase, £34.

The South Staffordshire Tramways Company.—The receipts for week ending March 10th, 1899, were £588 9s. 8d.; aggregate receipts for 10 weeks, £5,984 5s. 7d.; week ending March 11th, 1898, £533 18s. 5d.; aggregate receipts for 10 weeks, £5,789 10s. 4d.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, March 8th.	Closing Quotation, March 15th.	Business done during week ended March 15th, 1899. Highest.	Lowest.
124,400l	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	..
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	87 — 92	87 — 92	...	..
905,560l	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	65 — 68	65 — 68	66	6½
3,047,220l	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	117½—118½	116½—117½	118½	116½
3,047,220l	Do. do. Deferred	Stock	...	...	18s. %	14¼— 14⅜	13¾— 14¼	14⅜	13⅛
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	...	16 — 16½	16 — 16½	16⅜	16 1/16
75,000l	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2¾— 3¼	2¾— 3¼	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	190 —200	190 —200	...	...
1,332,523l	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	105 —107	105 —107	106½	105⅝
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	...	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	7 %	...	9½— 10½	9½— 10½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	17½— 18½	17½— 18½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 11	10 — 11	10⅝	10½
30,000l	Do. do. 4½ % Debs., Nos. 1 to 6,000	50	4½ %	4½ %	...	104 —107%	104 —107%	...	...
60,710l	Direct United States Cable	20	2½ %	...	...	12¼— 12⅜	12¼— 12⅜	12½	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	103 —106	103 —106	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	...	...	...	180 —185	180 —185	183	181
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	104 —107	104 —107	...	...
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	...	99 —102	99 —102	...	...
1,432,268l	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	126 —130	125 —129	127	125½
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	...	18 — 18½	18 — 18½	18½	18⅝
16,200l	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,040, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	..
64,400l	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000l	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	125 —129	125 —129	...	...
35,100l	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500l	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000l	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	102 —105	102 —105	...	...
200,000l	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	...	12⅜— 13¼	12⅜— 13¼	13¼	12⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	17 — 17½	16⅞— 17¼	17¼	16⅞
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	10 %	...	30 — 31	30 — 31	30⅜	...
97,800	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	57 — 60	57 — 60	...	...
100,000l	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	108 —111	108 —111	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	6 %	6 %	4½— 5	4⅜— 5¼	5	4½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	12 — 14	13½	13
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 15	12 — 14	13 5/16	12⅜
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4½— 5	4⅜— 5¼	5 1/16	4⅜
1,329,471l	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —101	99 —101	100⅛	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅝— ¾	11/16— 13/16	¾	...
100,000l	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	...	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	...	6½— 7½	6½— 7½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	139 —144	140 —145	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	...	...
151,733l	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000l	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	98 —101	99 —102	101¼	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	107 —110	107 —110	...	...
88,321	West India and Panama Telegraph	10	1 %	3%	...	1⅞— 2⅛	1⅞— 2⅛	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	10½— 11	10½— 11	10⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	9 — 10	9 — 10	...	...
80,000l	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	105 —108	105 —108	...	...
158,100l	Western Union of U.S. Telegraph, 6 % Ster. Bonds	100	6 %	6 %	...	98 —103	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	11½— 12½	11½— 12⅛xd	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½xd	6⅛	...
34,000	*Chelsea Electricity Supply, Ord.,	5	5 %	6 %	6 %	8½— 9½	8 — 9 xd	...	...
60,000	Do. do. do. % Deb. Stock Red.	Stock	4½ %	4½ %	...	114 —116	114 —116	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000	10	7 %	10 %	6 %	19½— 20½	18 — 19 xd	19⅞	18⅜
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	19 — 20	18 — 19 xd	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15 — 16	15 — 16 xd	15 11/16	15½
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	124 —129	124 —129	126½	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	*nil*	*nil*	*nil*	12 — 13	11½— 12½	12½	11⅜
10,000	Do. do. do. Nos. 30,001 to 40,000	10	...	...	...	12 — 13	11½— 12½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14½— 15½	14½— 15½	14⅜	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5¼— 5⅜	5¼— 5⅜	5 7/16	...
15,661	House-to-House Electric Light Supply, Ord., 101 to 15,761	5	...	4 %	6 %	9 — 10	8½— 9½xd	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	...	9½— 10½	9 — 10 xd	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7 xd	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	105 —107	107	105⅜
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	16½— 17½	16 — 17	16 15/16	16½
22,500	Do. Nos. 62,501 to 85,000, £7 paid	10	...	...	...	12½— 13½	12 — 13	...	...
220,000l	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	118 —121	117 —120	117	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	16½— 17½	16½— 17¼xd	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16½— 17½	16½— 17½	17 7/16	16¾
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9⅝	...
65,000	South London Electricity Supply, Ord., £3 paid	5	...	...	...	3½— 3¾	3½— 3¾	3⅝	3½
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	9 %	12 %	12 %	15½— 16½	15½— 16	16⅛	15½

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Mar. 8th.	Closing Quotation Mar. 15th.	Business done during week ended Mar. 15th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	3 — 3½	3 — 3⅛	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100	94 —100	...	...
80,000	British Electric Traction	10	...	...	...	17⅛— 18½	21 — 22	21⅞	18 5/16
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13½— 13⅝	13⅝— 14½	14	13½
100,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —127	126 —129	129	127½
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅞— 2⅛	2 — 2¼	2 1/16	2
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	103	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	12½— 13⅛	12½— 13⅛	13	12 1/16
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	114 —117	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9⅜— 10¼	10 1/16	10
178,303	Do. do. do. £8 paid	10	...	...	...	7⅞— 8⅛	7⅞— 8⅛	7 15/16	7⅞
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3½— 4	3½— 4	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4¼— 4⅜	4¼— 4⅜	...	...
630,000*l*	City and South London Railway	Stock	1 9/16 %	1⅞ %	2⅛ %	70 — 72	68 — 70	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4¾— 5⅛	4¾— 5⅛	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¼— 3⅜	3¼— 3⅜	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	98 — 101	98 —101	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	...	2¼— 2⅜	2¼— 2⅜	2 1/16	2 3/16
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	...	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	98 —100	97 — 99	99¾	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2¼— 2⅜	2¼— 2⅜	2 1/16	2⅜
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3⅛	3 — 3⅛	3⅛	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	104¾	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	5/8— 7/8	5/8— 7/8	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	9/16— 5/8	9/16— 5/8	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	27 — 28	26 — 27	26⅞	26
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½xd	19½	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	113 —116	112 —115 xd	115	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	22 — 23	22 — 23	22½	22
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3¼ %	3¼ %	10 — 10½	9 1/16—10 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14½— 15	14⅝— 14⅞	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	40 — 44	38 — 42 xd	39½	38½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	104 —107	104 —107	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9¾	10 — 10½	10⅜	10⅛
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5¾— 6¼	5¾— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	109 —112	109 —112	112	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10½—11½; 7 % Pref., 12—13.
House-to-House, 4½% Debentures of £100, 104—107.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7¾—8¼. Debentures, 107—110. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, ⅜—½.
Smithfield Market Electric, 3½—4½.
*T. Parker, £10 (fully paid), 15¾.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, March 15th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (grey) .. per ton	£19	£19	..
a " " (white) .. per ton	£26	£26	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£26	10/- dec.
a Lead, Nitrate .. .. .. per ton	£28 10	£28 10	..
a " White Sugar .. .. per ton	£30 10	£30 10	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8¾d.	9¾d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. .. per cwt.	67/-	67/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 15	£6 15	..
a " Recovered .. .. per ton	£5 15	£5 15	..
a " Lump .. .. .. per ton	£5 5	£5 5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	3d.	3d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£65 to £130	£65 to £130	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c " Tube (brazed) .. .. per lb.	10d.	10d.	..
c " Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£79	£79	..
g " Wire (basis price) .. per lb.	9¾d.	9¾d.	..
g " Sheet .. .. .. per ton	£79	£79	..
g " Rod .. .. .. per ton	£79	£79	..
h German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. .. per lb.	4/4½	4/4½	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	47/1	47/7½	6½d. dec.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£9 5	£9 5	..
g Lead, English Ingot .. .. per ton	£15	£15	..
g " Sheet .. .. per ton	£15	£15	..
l Mica (uncut slabs 8" long) .. per lb.	6/6	6/6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. .. per bottle	£8 5	£8 5	..
p Phosphor Bronze, plain castings per lb.	1/- to 1/4	1/- to 1/4	..
p " rolled bars & rods per lb.	1/- to 1/4	1/- to 1/4	..
p " r'l'd strip & sheet per lb.	From 1/2	From 1/2	..
o Platinum .. .. .. per oz.	£3 11 6	£3 6 6	5s. inc.
p Silicium Bronze Wire .. .. per lb.	10d. to 1/1	10d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. .. per ton	£115	£115	..
g " foil .. .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/6	1/6	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £65	£40 to £65	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j " Flax, 6 or 8 lea... .. per lb.	4d.	4d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j " " Russian, 10 lbs. per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£12	£12	..
j " Manila, 24 thread .. per ton	£33 10	£33 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£31	£31	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

NEED AN ENGINEER'S WORKSHOP BE DIRTY?

A contributor to the *Mechanical World* considers that though some amount of dirt is unavoidable it need not be so obvious and plentiful as it is. He enumerates dirt as caused more or less directly by want of light, or by earth, or dirt floors, moulding and borings, &c., graphitic carbon, rust and oil. All glass roofs are recommended on the score of light. Few shops can be well lighted from the sides, and the single floor shop is bound to succeed best. Hence, in big cities, good shops cannot, as a rule, be constructed for reasons of expense.

Floors of dirt are now less common. If they must be used water will not prevent the red dust of iron rust from rising. On this point a lesson might, perhaps, be taken from American railroads which have prevented dusty tracks by a fine spraying of petroleum. A concrete floor is good if kept clean, and so is wood. With concrete a machine can be put down anywhere and held fast. Holes can be easily filled up in a concrete floor, but they are cold. We have seen nice floors in a light machine shop made with nailing strips concreted in, and boards laid solid on the concrete. Such boards should be narrow.

As regards sand from castings, this is inexcusable. Castings ought to be cleaned out and cores thoroughly removed before they enter the machine shop. We have years ago seen a crank pedestal cap actually sent out finished for erection with a lot of core sand in the oil box. Our author recommends pickling and sand blasting to clean castings. Americans are great at pickling, and leave as little hard work as possible for machines to cope with. Why, it is asked, cannot castings be cleaned by steel brushes on flexible shafts? Then, as regards turnings and borings, these ought to be properly caught and provision should be made to catch all soap-water. In the best shops to-day machine tools are fed by pipes, which keep up a constant flow of oil or other lubricant to the cutting tool, such oil flowing through filters on its return. Rust is to be avoided by keeping a shop dry and warm, avoiding watering, which need not be done if a shop is kept clean. As regards oil, far too much is used, and splashes about everywhere. In one American shop, machines are painted white, and, if dirty, can be seen. They assist to keep a shop light. In a dirty shop the tidiest and best of men cannot keep themselves clean. As a rule men are wasteful and dirty as regards, say, the use of oil, which they use very carelessly. But old time workshops were not such as to encourage men to be clean. In the best modern shops, and, we believe, some of the German shops as well as many American, are models of convenience. But it is not the large workshops backed by capital which is difficult to keep clean; such shops can usually pick and choose their men. They can afford every necessary or desirable appliance, and they can compel its use or sack the man who won't be clean and careful. Smaller shops have not the means, they cannot pick and chose men and are more or less at the mercy of the men who, as we well know, will ruin any scheme of tidiness and curse it as a nuisance. Nor does a clean and tidy man always have a happy life in such shops. His fellows sneer at him as a "toff," a term which they qualify with the usual adjective suggestive of slaughter. The failing of the London workman is as a rule that he insists on wearing unsuitable clothes which cannot possibly keep clean, and he cannot possibly afford to buy enough new ones to keep reasonably tidy. In north country shops the men wear white cotton and appear fresh and clean on Monday. This rule seems to apply to the engine shops. In machine shops the men usually present a less tidy appearance. But tidiness and cleanliness may be overdone. We have known men who would, left to themselves, never get anything done beyond tidying up and keeping stock, always on the move to clean it, while important work was waiting to be done. This sort of thing is found where men have no sense of proportion. If a man is lacking in this sense he is usually hopeless. It may be concluded that a workshop need not of necessity be specially dirty, if it is kept clear of accumulated old stock, and the scrap heap is properly run.

THE VENTURI METER.

The Venturi meter is a contrivance for measuring large or small flows of water. It depends for its action upon the fact that when water flows through a tube of varying cross-section the pressure is less where the velocity of flow is greater. The form taken by the meter is that of a length of tube with a comparatively sudden reduction of diameter by a conical piece down to the throat diameter, and a longer cone tapering up to the original diameter at the discharge end or down-stream end.

If in such a pipe three vertical gauge tubes be inserted in the parallel pipe above and below the tapers, and also in the throat itself, the water level in the throat pipe will stand below that in the other two pipes or piezometers. As made, the Venturi meter consists simply (1) of such a constricted pipe as above described, and (2) of clockwork mechanism to register the pressure differences in the normal and constricted sections whereby the velocity of flow can be calculated and, therefrom, the volume. As the head causing velocity varies with the square of the velocity, and as the velocity in a filled pipe must be exactly proportional to the cross-section at any point, and as the pressure head at any point must correspondingly vary with the square of the velocity, being least at points of greatest velocity it is clear that the theory is simple. In the throat gauge tube, however, there may even be a vacuum and the minus head cannot then be measured, which is due to velocity. This difficulty is got over by using a mercury tube acting by suction, a small column of mercury being equivalent to a much greater pressure than a water column. Up to diameters of pipes not exceeding 60 inches, the Venturi tube is built up of sections of flanged pipes of the required taper to form the two truncated cones: the throat piece is separate and either made of or lined with gun-metal. Round the throat is the annular pressure chamber communicating with the throat by means of several holes drilled radially at equal circumferential distances. A similar pressure chamber is placed at the large end of the short or up-stream cone, and one may also be placed at the larger end of the down-stream cone for observations of final loss of head. In an 18-inch pipe the throat will be only 6⅜ diameter, or ⅓th the pipe area, while at any time by means of the piezometer gauge the pressure and flow can be found. This does not register. In the *Journal of the Franklin Institute* a registering apparatus is described as devised by Messrs. Connet and Jackson.

This apparatus registers the pressure at a given instant in terms of the total discharge since last registry, similar to a gas meter. It consists of a vessel connected by small tubes to the up-stream end, and the throat of the Venturi. One tube connects above the mercury in a well, the throat tube connects above the mercury in a tube with a small opening in its lower end into the mercury in the well tube. In this way a mercury pressure column is secured. The higher side of the column bears a float carrying a small wheel on a vertical spindle, and this wheel is pressed against a cylindrical drum which is periodically revolved about a vertical axis by mechanism. This drum carries a raised surface, the upper limit of which is formed spirally, and as the drum revolves this raised surface comes under the wheel of the float and lifts it slightly beyond the depressed surface of the drum. This raised surface makes contact with the wheel sooner or later, according as the velocity of flow through the throat holds the float low or high. In this way a high velocity causes a greater circumference of the drum to pass under the float wheel before the raised portion lifts the wheel and puts the drum out of gear, and terminates that period of registry. The total drum circumference represents a throat velocity of 38 feet per second. This is the highest velocity which can be registered.

The drum is tripped every 10 minutes, presumbly to an initial position, and one revolution is given to it. The actual reading of the apparatus is thus made on the assumption that the velocity during the period of that one revolution has been the same for 10 minutes. For such an approximation there appears quite an unnecessary complexity. A continuous record might, we think, be readily obtained by taking off the reading from the revolution of the wheel on the float spindle, and causing this to revolve by contact with a conoid drum, as in Ashton's second-power meter, or by means of the revolving disc of Ashton's first-power meter. Both of these give continuous records very simply. The Venturi meter has been tested at Holyoke and shown to register a discharge at throat velocities, of 9 to 50 feet per second, in small sizes, and 4 to 35 feet in the larger sizes, within 0 to 5 per cent. of the actual discharge, the registered flow being less than the actual. The Venturi tube can so easily be adapted on any pipe line, and is so little liable to stoppage, that it ought to prove useful on water-power installations. The Franklin Institute recommend it, but advise a continuous register. At the power station of the Pioneer Electric Power Company at Ogden, Utah, the 48-inch meters receive water from a 6 feet main, 4,000 feet long, at 400 feet head, which in turn receive it from a wooden flume 6 feet diameter and 3,000 feet long at 50 feet head. Throat ratios vary from 1 : 4½ to 1 : 16.

A JUST WAGE.

The second of the course of Monday free lectures was delivered at Glasgow University by Prof. Smart. He endeavoured to define a just wage, and he explained the constant slow rise in wages as due to the fact that wealth is increasing faster than population, and therefore the demand for labour goes up faster than supply.

Individual cases of hardship are due to the fact that in many trades man is still trying to compete with machinery. There is hardship during the process of conversion just as there would be, for a time, if Europe were to disband its armies and the men had to find their proper places as industrials. The idea of some people is, that an army represents so many men taken out of the competitive ranks. Such gross errors, of course, are those of superficial thinkers. The nations at large would benefit, and ultimately the soldiers would benefit, though they might suffer before they had found a means of becoming producers.

No man now produces the whole of one thing, so he cannot be paid the value of his labour by a close assessment. Hence arises the payment of fixed sums of money. The worker is kept from being ground down by various causes, chief among which is his personal liberty to go to another employer. Wages cannot be paid for any length of time above what the work will stand. Capital at most represents a store whence to pay wages, while the course of business turns work into money; but the employer who cannot extract a profit between the public purchase price and the cost of manufacture of the best-equipped rival manufacturer must go to the wall; and it is such men who get squeezed out by such external pressure. The wage earner as a class never looks on an employer as other than a thing to be squeezed. He has no thought to the means employed to bring together the weekly pay. The difficult point in the adjustment of all the factors of cost was, said Prof. Smart, that while the worker practically demanded that the employer should take

care to buy material at the cheapest price and generally cut down all cost factors to the lowest, including his own living, the one factor not to be reduced was the wage of the worker. By the system of municipal trading, the rottenness of which has been well shown up in the muddle of the London County Council, trades will be carried on at a loss by municipalities, and the loss will be juggled away at expense of the rates which are paid by the traders whom the municipalities seek to crush. Prices will be forced down to a minimum, and ruin will result to both traders and the municipal shops. It is to this end that such vestries as Battersea are fast tending. Now before any such system can be a success, absolute honesty is essential in everyone. Without this quality mankind could not endure a week of socialism. There would be one worker to nine idle loafers. But for this painful fact we could wish no better system.

With human nature as it is socialism is impossible, because the mass of socialists would not carry their share of the general load.

SOME EXPERIMENTS BEARING ON THE THEORY OF VOLTAIC ACTION.*

By J. BROWN.

In former papers on the "Theory of Voltaic Action"† I have adduced evidence in support of the view that the difference of electric potential observed near the surface of two metals in contact is caused, or at all events, mainly influenced, by the chemical activity of films condensed on their surfaces from the atmosphere (vapour or gas) in which the metals are immersed. From this view it would naturally follow that, if all chemically active films and all atmosphere competent to produce them could be removed, the difference of potential would disappear also. This inference has been pointed out and acted upon by previous experimenters, as is well known; but it appeared to me that no certain test of the theory could be obtained in the way they suggested without elaborate precautions as regards details; and the experiments here to be described were undertaken in the hope that more definite results might follow greater care in the work.

The method adopted was to enclose a copper-zinc volta condenser in a glass tube containing nitrogen at a small pressure, together with metallic potassium and sodium, the expectation being that these metals would absorb any remaining water vapour or other agents (compounds of oxygen, &c.) that could exert chemical action on the zinc.

The condenser is represented in the figure. Its plates are 101 mm. long by 47 mm. wide. The copper plate, C, has prolongations at both ends, to which are attached the fittings, D E, and the springs, B S, for the support of the whole system in its glass tube. To the prolongation, A, of the copper plate is hinged, on pointed screws, a brass sleeve, into which is cemented the glass plate, G, as an insulating support for the zinc, Z. The free end of the glass plate hangs in a notch in the fitting, E, and can move to the extent of the width of this notch, so as to separate the plates when the condenser with its tube is tilted over till the zinc falls away from the copper. Two curved springs of strip steel are placed between the glass and the zinc, to keep them apart; while they are held together by three screws, passing through the glass, and about half way through the zinc. These screws also serve to keep the copper and zinc, when in their position of nearest approach, at the uniform distance of about 0·03 mm.

The surfaces of the plates were made true by careful filing, scraping, and testing by a surface plate. Platinum-tipped contact springs, P V, are provided to make connection with platinum wires sealed into the containing tube, which is of lead glass, 53 mm. diameter, and about 30 cm. long, with a leading tube attached on one side. The measurement of the difference of potential was made by a well-known zero method. The deflection given by a quadrant electrometer, on separating the condenser plates, was annulled by connecting the plates to points in a circuit of variable high resistance, containing a large gravity Daniell cell; the electromotive force required thus to anneal being taken as equal, and opposite to the difference of electrostatic potential at the plates. Three similar sets of measurements were made with this apparatus, continuing after it had been sealed up respectively 6 months, 1½ years, and 7½ years. In the intervals between observations the plates remained out of metallic contact, and were kept, in Experiment I. at their greatest distance apart; in III. generally at their least. My notes of Experiment II. are not clear on this point.

Experiment I., started December 12th, 1888.—The plates having been cleaned with fine glass paper, the condenser was slipped into its tube. A small porcelain cup of phosphorus pentoxide was introduced, in order to dry out the interior, and the tube was then temporarily closed. The difference of potential was then found to be 0·74 volt

The end of the main tube was then sealed at the blowpipe. The tube was exhausted through the side tube by a Sprengel pump, then filled with nitrogen, again exhausted, and then refilled with nitrogen. The condenser plates were now found to be in metallic contact, presumably due to the accidental sucking in of some minute globule of mercury from the pump. In three days this contact ceased. About 3 grammes of potassium and 1 gramme of sodium, in small pieces, were now inserted by the side tube. (My notes do not state that the capsule of phosphorus pentoxide was removed before closing the tube, but probably it was.) The tube was again, December 17th, exhausted to 3 mm., and refilled with nitrogen, when the difference of potential was found to be about 0·64 volt.

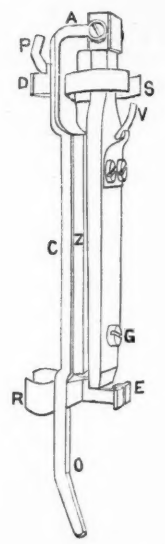
The tube was finally exhausted to 4·5 mm., and the side tube was sealed off, the difference of potential being 0·61 volt.

The following observations were then made at the intervals noted in days after thus starting the experiment:—

Days...	13	25	27	30	61	106	173	181
Volts...	0·56	0·52	0·55	0·51	0·47	0·34	0·32	0·33

It remained to ascertain whether the fall in potential difference was due to the gradual absorption of chemically active matters by the potassium and sodium, or to the well-known effect of gradual tarnishing of the zinc surface. If, on admitting air and moisture to the tube, the potential difference increased, the former alternative would be indicated, and the absence of such increase would indicate the other alternative.

Before testing this point, it was thought desirable to ascertain whether the pressure originally in the tube had changed. To measure



the pressure, the sealed end of the leading tube was joined by a rubber tube and mercury seal to the Sprengel pump, which was worked till the pump gauge showed a pressure of about 2 mm. The end of the leading tube was then broken off in the inside of this rubber tube, a notch having previously been filed to facilitate breaking. The pump gauge then fell, and ultimately stood at 90 mm. pressure, showing that a considerable amount of gas had been evolved in the tube during its six months' trial.

The leading tube was now removed from the pump, and air admitted; air was also blown in by the mouth, to introduce moisture. The difference of potential at once rose to 0·39 volt, and later to 0·48 volt.

On taking out and examining the condenser, the zinc was found to be tarnished at the edges, but not much in the middle of its surface; the sodium was scarcely altered, but the potassium had a thick coat of, no doubt, oxide or hydrate, covering a core which burned on water.

Experiment II., started December 9th, 1889.—This was intended to be practically a repetition of Experiment I. In closing the end of the main tube, a considerable amount of fumes and moisture from the gas blowpipe was observed to get into it, which may have affected the condition of the zinc surface. The moisture was removed by warming the tube and washing out with air. Eight grammes of potassium were inserted, but no sodium. The nitrogen pressure before sealing off was 5 mm. After sealing off, the difference of potential was found to be 0·70 volt, and fell thereafter more or less regularly for 1½ years, when, on June 9th, 1891, it had diminished to 0·52 volt.

On opening the tube this value did not sensibly change. The fall in difference of potential was therefore probably due to the tarnishing of the zinc merely. The potassium in the tube was very little altered.

Experiment III., started June 15th, 1891.—The arrangement was the same as in Experiment I, except that, after the tube had been exhausted, and finally sealed off, the 9 grammes of potassium and 3 grammes of sodium which had been introduced, were fused together, forming the alloy that is liquid at ordinary temperatures. The difference of potential was at first about 0·75 volt.

During the first year, the whole tube (except when being examined) was kept immersed in a bath of petroleum, to prevent leakage of air, in case of minute imperfections at the sealed-in wires or elsewhere. The difference of potential on July 22nd, 1892, was about 0·67 volt.

The tube, no longer kept in petroleum, was examined occasionally

* Communicated to the Royal Society by Prof. Everett, F.R.S. Received February 4th.—Read February 23rd, 1899.

† *Phil. Mag*, Vol. 6 (1878), p. 141; *ibid.*, Vol. 7 (1879), p. 109; *Roy. Soc. Proc.*, Vol. 41 (1886), p. 294.

for the next 6½ years, till November 4th, 1898, when it was opened The pressure had risen to about 59 mm. of mercury. The difference of potential just before opening was about 0 49 volt, and after opening and blowing in there was little appreciable change in this value. If anything, it seemed rather lower, though the rapid tarnishing of the potassium-sodium alloy, when a new surface of it was exposed, indicated the presence of an ample amount of oxidising medium. The decrease of potential difference, in this case also, was therefore probably due to tarnishing of the zinc surface. The zinc was almost as bright as when enclosed 7½ years before; but polishing a small portion of its surface with glass paper showed that a slight film had formed.

Of the three experiments, the first is the only one that lends any support to the hypothesis they were designed to illustrate. The laboratory notes show no difference between the first experiment and the other two, beyond what may be gathered from the foregoing account. It seems unlikely that the three days of accidental metallic contact in the first experiment, or the distance apart of the plates in intervals between observations, can have affected the result, and I am unable to suggest any other explanation, except the possibility that the phosphorus pentoxide was left in the tube, as well as the potassium and sodium. I found on a previous occasion* that when this substance was enclosed with a copper-zinc pair, so as to dry the air surrounding the pair, the difference of potential fell in 134 days by one-sixth of its first value, and rose to its original amount immediately on admission of the ordinary atmosphere. In No. III. certainly no phosphorus pentoxide was enclosed, and there is no mention of it in my notes of No. II.

Though the experiments cannot be quoted as confirming the chemical hypothesis, which I still think to be supported by an overwhelming weight of evidence, it has been thought worth while to describe them, if only to show the extreme difficulty of eliminating the last traces of active matter from the gas employed. That this is the real difficulty in the way of obtaining positive results is well illustrated by the ingenious experiments of C. Christiansen.† He found, among other things, that when the metal (of a pair) near which positive potential is usually observed is exposed, for a minute fraction of a second, to an inactive gas, such as hydrogen, the observed potential difference is very much smaller than when the exposure lasts for a considerable time. The metal exposed by Christiansen was a jet of liquid amalgam, flowing from a drawn out glass tube. Its surface was thus perfectly clean, and the time of exposure to the surrounding gas was merely the interval between the instant at which the amalgam left the nozzle and that at which it broke into drops. The difference of potential observed, when carbon was opposed to a jet of zinc amalgam in hydrogen in this manner, was only 0·15 volt, while in air it was 0 89 volt. If more time had been allowed, the impurities in the hydrogen would have been diffused in larger quantity towards the zinc, and given a larger effect, similar in character to that observed in my experiments, where the metals are exposed to the gas for a period amply sufficient for all such action.

* *Roy. Soc. Proc.*, Vol. 41 (1886), p. 305.

† *Wied. Ann.*, Vol. 56 (1895), p. 644.

MUNICIPAL EXTRAVAGANCE.

It is nothing new to find members of vestrys and town councils going in a body to inspect works in other towns and countries. It is in this way that these good men pay themselves for sacrificing their leisure to the good of the community. If a mechanical stoker is wanted at the local gas works, the gas committee go to other towns ostensibly to find out, at the cost of many scores of pounds, what their own paid servant, the gas engineer, either fully knows already, or could learn in a day for himself at a mere fraction of the cost of the deputation. Of what use is it for a town council to employ professional servants when they are not so competent to make tours of observation as the baker, hatter, or pork butcher of the self-constituted deputation from the council. It has been suggested that all the responsibility should not be thrown on the engineer. We venture to say that whether he have or have not the support of a high feeding body of the council in coming to a decision, he will have to bear all the blame should the choice made not prove satisfactory. Municipal electricity suffers just as much as water, gas, or other things municipal. For years America has had electric traction in full swing, yet here we have town councillors bleating about risking the public money on experiments.

It is absolutely absurd to read such rubbish at this late hour, and we fear that much of the care for the public funds arises purely and simply from a desire to make a Continental tour of inspection. Granted that the engineer himself should not go alone, would it not be quite sufficient for one member of the committee to accompany him? There is often one man on the committee able to grasp the technicalities of a subject better than all the others, and he ought to be the man to support the engineer. If the engineer is not capable of doing this work, a few shillings should be paid to advertise for his successor. It is unfair to the public to spend their money in paying for an engineer, and then to spend ten times more to convey a deputation several hundred miles to see, say, a tramway at work on some principle well known to all engineers, and in no more need of a committee of inspection than a garden roller or coffee mill. Foreigners, who see the very backward condition of London in respect of electric traction, are apt to consider the fact as evidence of the inability of English engineers to carry the work out.

As a fact, we all know that the backward condition of London is simply the result of the peculiar temper of the London County Council, which, in order to exploit its policy of backwardation, professes to be seeking some better system than that known as the trolley system. We all know that there is no better system, and while overhead wires may not be altogether sightly, it is indisputable that there are few tramway routes in London suburbs which would be at all disfigured by them. The overhead system is hardly noticeable in Dublin or Coventry, so little does it obtrude itself on the notice of a pedestrian. Let one particular London tramway line be considered, that from Vauxhall to West Norwood. The present service is very slow and loses passengers. A few days ago the writer walked from Loughborough to West Norwood waiting for a car, and in all that distance not a car overtook him. With electrical traction three times the number of cars would be filled if the fares were made more reasonable and the stages better divided. As it is a would-be passenger may walk half the journey and still find he has the same fare to pay as though he had walked the other way to meet the car. Now, along the whole route from West Norwood to Vauxhall there is no portion which can be pronounced so sightly as to be in danger of uglification by a trolley wire and poles. Surface contact systems may some day be made a success. At present they are not so, and an engineer recently returned from Paris was very insistent as to the terrific sparking on the line from the Place de la Bastille. The English industry of electric traction is being played with and seriously damaged by narrow-minded municipal control or rather obstruction. Committee men swelling with self-importance feel big when they are obstructing progress. Possibly they feel they are doing something. Anybody can obstruct. Men of intellect alone can guide and direct progress.

England's resources are simply frittered away by meddlesome busybodies. Municipalism ought to spell progress; as it is, it simply spells another kind of individualism. The electric lines of England ought to be on some large system, with towns threaded on like beads. Under blind leadership the towns are becoming like isolated spider's webs, with no outside continuation and no through traffic. This is a danger that ought to be guarded against, and if Parliament were not so busy on party squabblings, it might find time to put a check on the narrowing influences of municipal individualism. We want more real socialism, not the sham article of the agitator pattern.

PHYSICAL SOCIETY.

Ordinary Meeting, March 10th, 1899.

Prof. Oliver Lodge, F.R.S., President, in the Chair.

Mr. A. A. Campbell Swinton described and exhibited the Wehnelt current interrupter. A glass cell contains a large cylindrical negative electrode of lead, and a small positive electrode consisting of a platinum wire about $\frac{1}{16}$th inch or $\frac{1}{8}$ inch in length in a solution of one part sulphuric acid to about five parts water. The platinum wire may project from the top of the shorter arm of a J-shaped ebonite tube, so that it can point upwards immersed in the solution. Or it may be fused into a similar glass tube; but glass is apt to crack in the subsequent heating. Wehnelt's interrupter replaces the make-and-break apparatus of an induction coil; it also replaces the ordinary condenser of that apparatus. In its present form it requires rather a strong current The resulting spark at the secondary terminals differs in character from the ordinary spark of an induction coil; it is almost unidirectional, and in air takes a V-form, bright, continuous, and inverted – somewhat like a pair of flaming swords rapidly crossing and recrossing one another at their points. By blowing upon the V it breaks up, and then more nearly resembles the customary discharge of a coil. The sound emitted by the spark has a pitch that varies with the conditions of the circuit. As the self-induction of the circuit is diminished, the spark-pitch rises; it becomes infinite when the self-induction vanishes, *i.e.*, the Wehnelt interrupter will not work in a circuit devoid of self-induction. As the applied potential difference diminishes the spark-pitch diminishes. In Mr. Campbell Swinton's experiments 25 volts was the minimum primary voltage at which his apparatus would work. The spark-pitch also varies with the length of the platinum wire electrode in the solution. If the circuit is closed by dipping this electrode into the solution, the apparatus will not work; the wire must be dipped in before closing the circuit. After working for about a quarter of an hour the action often ceases; this fatigue effect is not due to heating of the solution, for it is not obviated by keeping the temperature constant by a water bath. It is supposed that the oxygen generated at the platinum electrode forms a more or less insulating film which interrupts the current until absorbed by the surrounding water. The fact that oxygen is more easily absorbed than hydrogen may explain why it is necessary to connect the platinum electrode to the positive pole of the battery or dynamo. When the platinum electrode is dipped gradually into the solution, the wire gets red hot, and the interruptions do not take place. Again, when the apparatus stops, from fatigue, the platinum gets red hot. The action is further complicated by a series of small explosions, and by the formation of a kind of electric arc at the platinum electrode. The coil exhibited was connected to the 100-volt electric light mains at Burlington House. In this case the potential difference at the terminals of the primary was 30 volts, and that across the interrupter, 150 volts—a total of 180 volts, showing the effect of impedance. For Röntgen ray work the apparatus would be very effective, but, unfortunately, the sparks produce great heating, so that the cathodes of tubes are melted. Mr. Campbell Swinton suggested that as the sparks were more nearly continuous than ordinary discharges they might produce Hertz waves less rapidly attenuated than those now applied to wireless telegraphy; the trains of waves would also follow one another at shorter intervals than those from the sparks at present employed.

The President said he was rather surprised that the self-induction of the primary coil was not sufficient of itself to form the induction factor in the impedance necessary for perfect working. He would

like to know how the apparatus behaved when an alternating current was used. Did the secondary coil become damaged by over heating? Did reversal of the current assist the recovery from the fatigued condition of the apparatus? The natural period of the circuit depended upon its capacity and its self-induction. There was undoubtedly capacity at the surface of the platinum electrode in the liquid. This capacity acted together with the auxiliary self-induction, and the self-induction of the rest of the circuit, in the orthodox way, and there was automatic adjustment of resonance to the frequency of the interruptions, probably by variations of the capacity at the electrode. The heating effect, when a wire was made to close a circuit with a liquid, was discovered many years ago.

Prof. G. M. Minchin thought that the usefulness of the apparatus would be greatly increased if it could be made to work with less current. He had himself succeeded with 12 applied volts, but not with 10 volts. As a tentative experiment, he had used a horizontal lead plate, with disastrous effect, for the apparatus went suddenly to pieces. Explosions were frequently obtained, but they were not attended with much real danger. In a later and safer apparatus he used a platinum wire about $\frac{3}{4}$-inch long, projecting from a glass tube, around which the lead plate was bent. There appeared to be a definite depth of immersion of this wire, at which the apparatus worked with minimum current. In his apparatus this critical position was when half the wire was below the surface of the liquid, the other half projecting into the air. He attributed the fatigue to the presence of gas about the electrodes, for he observed that a mechanical tap to the base of the apparatus restored the working condition.

Mr. Rollo Appleyard pointed out that the improved result at half immersion, observed by Prof. Minchin, taken together with the phenomena described by Mr. Campbell Swinton as to the effect of dipping the electrodes into the solution, suggested that the liquid immediately around the submerged part of the wire was at some instants in the spheroidal state. The breaking down of the spheroidal state would be facilitated by heat lost by the immersed part to the non-immersed part of the wire. The capacity for heat of the non-immersed part, and the degree of roughness or smoothness of the immersed part, would thus appear as factors in the explanation. No doubt the evolved gases were the primary cause of the interruption of current, but the wire having once become red hot, the spheroidal condition would introduce a further cause of electrical separation between the wire and the liquid.

Prof. V. Boys asked whether it was the liquid or the electrodes that became fatigued. Experiments should be made to determine the effect of variations in the hydrostatic pressure around the platinum electrode.

Mr. T. H. Blakesley said that the rise of potential at the terminals of the interrupter proved that the arrangement possessed capacity. Such a rise of potential could not occur without there being capacity, any more than it could without self-induction.

Mr. D. K. Morris described experiments he had made with a Wehnelt interrupter, using a 1 kilowatt transformer with a transformation of 4 to 5, intended for 10 amperes at 100 volts. The anode of the interrupter was designed to have an adjustable surface to correspond with the load on the secondary—a platinum wire at the end of a copper wire could be projected more or less through the drawn-out lower end of a glass tube containing oil. The best results with the interrupter were obtained with about 45 volts on the primary circuit. At this pressure, an average current of 1 ampere sufficed to give 125 (alternating) volts very steadily on the secondary. As measured by an electrostatic instrument, the "no-load" loss was only 45 watts. The secondary could then be loaded up with lamps, provided that the exposed surface of the platinum wire was proportionately increased. The energy delivered to the lamps, however, was not at any load much greater than 45 per cent. of that taken from the mains. By connecting the interrupter with a condenser of $\frac{1}{2}$ microfarad, the efficiency at small loads was increased to nearly 60 per cent. He had observed that the fatigue of the interrupter could be temporarily remedied by reversing the current.

Mr. C. E. S. Phillips asked whether Mr. Campbell Swinton had tried other liquids than dilute sulphuric acid. So far as his own experiments went, he had only obtained good results with that electrolyte.

Mr. Campbell Swinton, in reply, said that with the apparatus arranged in a simple circuit an alternating current applied to the primary of an induction coil through a Wehnelt interrupter produced only about half the effect of the corresponding direct current—apparently, only half the alternations got through. But if two interrupters were connected in parallel circuits, it was possible so to arrange them that one took one half and the other the second half of the alternations. It might, therefore, be possible to design an induction coil, with two primary windings to correspond to the two interrupters, so as to give an additive effect. The induction coil he had used had suffered no damage from the currents employed in the experiments exhibited: there was extremely little heating of the secondary. He could not with his apparatus restore the working condition by any mechanical disturbance of the interrupter. Hydrochloric acid failed, but a saturated solution of potassic bichromate gave fair results.

The President, in proposing thanks, said he did not agree with Mr. Campbell Swinton's remarks as to the chances of improving Hertzian telegraphy by the use of these interrupters. The rate of interruption with this apparatus was something like 1,000 per second, but the vibrations corresponding to Hertz waves were of the order 100,000 per second. The wave trains from oscillators excited by the new interrupter would still be a series of damped vibrations; the amplitudes would not be maintained. It might be advantageous to have sparks following one another so rapidly, but he doubted it. For Hertzian telegraphy the spark at the oscillator should "crackle." To produce the best effect, the air about the oscillator should be in a non-electric condition.

THE KR LAW.

By W. MOON.

(*Concluded from page* 353.)

All the preceding formulæ can, of course, be applied to telephony.

From (5),

$$l = \frac{\log.\frac{E}{C} + \log. 2\sqrt{\frac{K\,2\,\pi}{\rho\,T}}}{\sqrt{\frac{K\,\rho\,\pi}{T}}} \qquad (10)$$

and

$$\frac{E}{C} = \frac{\varepsilon^{\sqrt{\frac{K\rho\pi}{T}}\,l}}{2\sqrt{\frac{K\,2\,\pi}{\rho\,T}}}. \qquad (11)$$

Taking as a standard line an 800-lb. per mile copper wire with a capacity of $\cdot0155 \times 10^{-6}$ farads and a resistance of 1·113 ohm per mile, with $l = 1{,}000$ and $T = \frac{1}{360}$ second,

$$\frac{E}{C} = 17{,}820, \qquad (12)$$

filling this value of $\frac{E}{C}$ in (10).

$$l = \frac{9\,788 + \log. 2\sqrt{\frac{K\,2\,\pi}{\rho\,T}}}{\sqrt{\frac{K\,\rho\,\pi}{T}}} \qquad (13)$$

$$= \frac{\cdot348 + \frac{1}{42}\log.\sqrt{\frac{K}{\rho}}}{\sqrt{K\,\rho}}; \qquad (14)$$

or, if K is in microfarads with common logs.,

$$l = \frac{182 + 54{\cdot}9\log.\sqrt{\frac{K}{\rho}}}{\sqrt{K\,\rho}}. \qquad (15)$$

Taking the same line as standard, the K R formula may, for comparison, be written—

$$l = \frac{131}{\sqrt{K\,\rho}} \qquad (16)$$

From these formulæ (15) and (16) the following table has been calculated :—

	K microfarads.	ρ ohms.	l from Blakesley.	l from K R.	Relative diameters of wires.
100 lbs. copper	·0127	8 901	310	390	354
200 „ „	·0135	4 451	460	535	500
400 „ „	·0145	2 225	677	725	708
Standard 800 „ „	·0155	1·113	1,000	1,000	1,000
400 „ iron	·0146	13·5	225	296	...
$\frac{18}{7\frac{1}{2}}$ G.P. ...	·25	23·	53 5	51·2	...
$\frac{14}{2}$ cable ...	·29	8 4	91	78·5	...

It will be seen from this table that neither formula gives results far from the relative diameter of the wires in the case of aerial copper wires.

It is found by experiment that the limiting distances of speech on iron wires and covered wires is less than that given by the K R law, and in practice a lower constant than that given in (16) is used for these wires. (Preece and Maier, page 125.)

In the case of iron wires this departure from the K R formula might be either due to the greater inductance of the wire itself, or to its higher specific resistance.

A good deal of uncertainty must attach to any experiments made with voices in telephony, owing to the different pitch of the voices of different individuals. For a good bass voice travels farther than a shrill treble. Formula (13) illustrates this, since a pitch of 140 would give a distance of 1,760 miles on an 800-lb. wire, instead of the 1,000 miles with a pitch of 560.

The ratio, $\frac{E}{C}$ in (12) enables the current to be calculated if the E.M.F. is known.

Taking the E.M.F. as $\frac{1}{10}$th volt,

$$C = \frac{1}{178{,}000} \text{ amperes} = 5{\cdot}6 \text{ micro-amperes.}$$

This current is 10^7 times as great as that given by Mr. Preece in 1887 as the minimum current that a telephone will respond to. From formula (10) it will be found that the current received would be 6×10^{-13} amperes on a line of 3,900 miles of 800-lb. copper wire.

This very rapid attenuation of the signals where alternating currents follow each other on a line, might perhaps be prevented by inserting transformers in the line at a less distance apart than a half wave length. The use of transformers in this manner would make the limiting distance in telephony more a question of inductance than of capacity.

For short lines of but fractions of a wave length the current would of course approach more and more nearly to $\frac{E}{R}$ or allowing for the inductance to

$$\frac{E}{\sqrt{R^2 + p^2 L^2}}$$

The Blakesley formulæ gives the ratio of the current sent to that received as

$$\frac{1}{2} \varepsilon^{\sqrt{\frac{K \rho \pi}{T}} l} \text{ nearly.}$$

For the wires given in the table this formula would give the current sent as 200 to 300 times that received.

A telephonic receiver responds to very weak currents, and the range of current strengths is very much greater than the range of the corresponding volume of sound produced.

In all that has proceeded, this question has been treated from a standpoint of resistance and capacity alone. With the slow alternations of cable working in telegraphy it is possible that inductance does not much affect the speed, but the high frequency of telephonic currents would lead one to suppose that inductance must have some appreciable effect in telephony.

To form some impression of the part played by inductance, I have calculated its value for four lines from Maxwell's formula for a looped circuit

$$L = 2\,l \left(\log. \frac{4\,D^2}{d^2} + \tfrac{1}{2} \right)$$

from which if l is taken in miles, L in henrys, with common logs.

$$L = l \cdot 00148 \left(\log. \frac{2\,D}{d} + \cdot 1085 \right),$$

where "d" is the diameter of the wires and "D" their distance apart.

With wires rotated in foot squares.

Gauge.	d.	$\frac{2\,D}{d}$	L per mile.
100 lbs.	·079	430	·00405
200 „	·112	314	·00385
400 „	·158	235	·00365
800 „	·224	152	0034
Minimum of L two wires touching ...	...	2	·00061

With a maximum and minimum pitch of voice of 560 and 90 the impedance of a mile of wire would vary between

$$\sqrt{R^2 + 12 \times 10^6 L^2} \text{ and } \sqrt{R^2 + 3 \times 10^5 L^2},$$

and this gives maximum and minimum impedances for the four wires shown in the last table of

Gauge.	R.	Maximum impedance.	Minimum impedance.
100 lbs.	8·9	16·6	9·15
200 „	4·45	14·05	4·92
400 „	2·225	12·8	2·99
800 „	1·113	11·8	2·17

Although these figures may convey some impression of the part played by the inductance of the wire, they are not of themselves of any use, since to get the impedance of a circuit, the total resistance and the total inductance must be filled in in the formula $\sqrt{R^2 + p^2 L^2}$, and the result would only then be accurate when the length of the line was but a fraction of the wave length, and the capacity of the wire small to the resistance and inductance.

Owing to the rapid attenuation of the current when several waves follow each other in a line, it is possible that the limiting distance in telephony is simply so many wave lengths —possibly only one or two wave lengths.

Although it was proposed to measure the wave length and velocity of reversals in a cable many years since, yet no such measurements have apparently yet been made.

Before any advance can be made in the theory of telephonic transmission, it will be necessary to measure the wave length and velocity, and the ratio of the current sent to that received, when alternations of different periods are sent over lines of different lengths, resistances, capacities, inductances, and specific resistances.

With the aid of a number of such measurements it would not be difficult to arrive at formula, which, if even empirical, would still be free from any doubt as to their accuracy.

Such measurements could, not, of course, be made with the low E.M.Fs. used in telephony, but results obtained from, say, 200 volts, would be exactly comparable with the lower E.M.Fs. of telephony.

Nor would the fact that such measurements are only comparable with the vowel sounds in telephony diminish their value, as the vowel sounds and ordinary speech can in ordinary telephony be compared with each other.

ON OSCILLATORY AND ROTATORY MAGNETIC FIELDS, AND THE THEORY OF THE SINGLE-PHASE MOTOR

By MICHAEL B. FIELD.

(*Continued from page* 272.)

As the field distributions sweep round the rotor they induce waves of E.M.F., which exactly keep step with them, but the waves of current lag behind their corresponding E.M.F. waves by the angles $\tan^{-1} \frac{L(n_1 \pm n_3)}{R}$.

We see then that the maximum of the forward travelling current wave will be at b, being directed downwards, whereas the maximum of the backward travelling wave will be at c, and will be also directed downwards.

The relative values of these two maxima will be as—

$$\frac{n_1 - n_3}{\sqrt{R^2 + L^2 (n_1 - n_3)^2}} : \frac{n_1 + n_3}{\sqrt{R^2 + L^2 (n_1 + n_3)^2}}$$

or as the perpendicular distances of the points, b and c, from the vertical axis, o n_1. In order to counterbalance the effect of these rotor currents, we need precisely similar, equal, and opposite stator waves. The balancing stator waves will have their maxima, therefore, at d and e, respectively, the current in these bars being directed upwards. Along the radii, o b, o c, we will, therefore, strike off distances equal to $b\,f$ or $c\,g$, respectively, letting these indicate vectors which represent to some scale the magnitude and position of the two balancing stator waves (C_3).

Again, we need a further stator wave (C_F), of which the maximum lies along o A, directed upwards at h to maintain F_f, and an equal one directed upwards at k to maintain F_b. Representing these to the same scale as the previous current waves, we may compound them, and arrive at the result that in order that two equal sinusoidal field distributions may exist in the air space, the one rotating forwards and the other backwards with the velocity n_1, while the rotor rotates forward with the velocity n_3, two current waves are essential in the stator, the larger represented by the vector o x_b rotating backwards, and the smaller by the vector o x_f rotating with the same velocity forwards.

Now, two sinusoidal waves of different magnitudes cannot combine to give an oscillating or pulsating wave, if, however, we reduce F_b in the ratio $O X_f : O X_b$ we should obtain as the stator wave necessary for the maintenance of the same, a current wave the magnitude of which was equal to $O X_f$. We should then have arrived at two rotating fields for the maintenance of which two equal and oppositely rotating stator waves were necessary. But these stator waves would be identically equivalent to an oscillating wave as actually exists in the stator of the single-phase motor. In fact, if we consider the case of a stator completely wound but with the current-carrying wires crowded together towards the centre of each winding so that, although the current per wire was the same throughout, the total current per unit circumferential arc of stator followed approximately a sine law, we should have with considerable accuracy the identical case we have arrived at above. This indeed, although not met with in practice, is the simplest form of single phase motor about which we can speculate, and as the deductions we can draw from this hypothetical case are also true, though to a modified extent, of all other single-phase motors, we will pause to examine the inherent characteristics of our hypothetical motor.

First, then, referring again to fig. 4, and remembering that the rotor torque due to a given rotating field is represented by the $C^2 R$ loss in the rotor bars divided by the

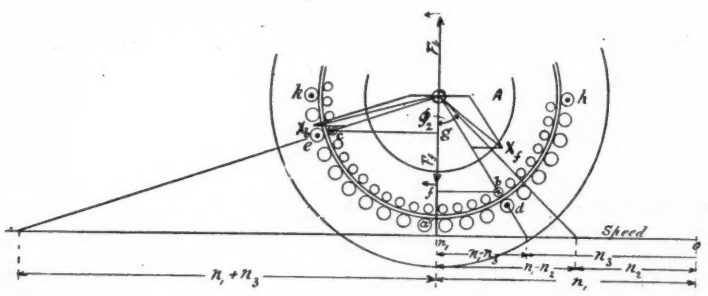


Fig. 4.

relative slip between rotor and rotating field, we see that when $n_3 = o$ two equal and opposite torques are exerted on the rotor. There is, consequently, no initial resultant torque, and the field distribution in which the rotor finds itself is purely oscillatory.

We next see that as n_3 increases from zero up to a speed near synchronism, the backward field, which at speed $n_3 = o$ was equal in strength to the forward one, rapidly becomes weaker and weaker, and since the backward and forward have, when combined together, to produce a definite back E.M.F. in the stator windings (or roughly one equal and opposite to that of the supply) the forward field must grow to the same extent as the backward field wanes, and consequently the resultant torque on the rotor rapidly increases.

Thirdly, we see that when synchronism is nearly reached the backward rotating field is reduced to a very small amount, so that we may say the reactionary effects of the rotor currents is to transform an oscillating into a nearly pure rotating field.

Fourthly, it appears that the currents in the rotor consist of two waves of different frequency but approximately equal in magnitude, the one being created by the large field rotating forwards with low frequency relatively to the rotor, the other by the small field rotating backwards with high frequency relatively to the rotor. The $C^2 R$ losses in the rotor must, therefore, be about double those of the corresponding rotary field motor, and the no load current of the single-phase motor nearly double that of the magnetising current (or that current which would flow into the stator if the rotor were on open circuit).

Fifthly, we see that there is a speed limit before actual synchronism is reached, at which the torque becomes zero, and after which the torque becomes negative. This is evident, for if the rotor be running synchronously, clearly the forward field can produce no torque; the backward one, however, produces a negative torque. The transition point from positive to negative torque must, therefore, occur before synchronism is reached.

Sixthly, it becomes clear that self-induction in the rotor is altogether detrimental, for although its effect is to decrease the backward torque as well as the forward one, the net resultant torque is also diminished. Lastly, we stumble up against a most interesting paradoxical question by asking ourselves what would happen if we could make our magnetic circuit with so small a magnetic reluctance as to render the magnetising current practically zero and revolve the rotor at synchronous speed. An examination of our diagram shows us that the resultant field would be purely rotating though no currents exist in the rotor. In other words, since the magnetic reluctance of our circuit has been reduced to zero, infinitesimally small rotor currents will suffice to entirely obliterate the backwardly rotating field.

It is interesting to note that the rotating field which exists in the air gap of a single-phase motor in virtue of the reaction of the rotor currents can be employed for the generation of multiphase currents. We have, in fact, a single-phase—multiphase converter.

It is a well-known fact that if a number of two-phase motors be connected up to a two-phase circuit and only one phase be fed from a single-phase generator as shown diagrammatically in fig. 5 so long as a sufficient number are in action others may be stopped and started just as two-phase motors. What really takes place is, that the two-phase motors in action being only fed with single-phase currents act partly as single-phase motors and partly as single-phase—two-phase converters, circulating among themselves the necessary second phase current to produce a considerable starting torque in those motors which may be stationary.

An example of this may be given in the following fact:—If one phase of a two-phase motor be connected to a live circuit no E.M.F. is induced in the second phase winding so long as the rotor is at rest, if, however, the motor be first started as a two-phaser, and one phase be then disconnected so that the motor continues running as a single-phase motor, a considerable voltage (of the order of $\frac{4}{5}$ths of that obtaining in the primary phase), will be found to exist at the terminals of the secondary one.

We must now return and develop more fully our hypothetical motor. We arrived at the result that if we supply

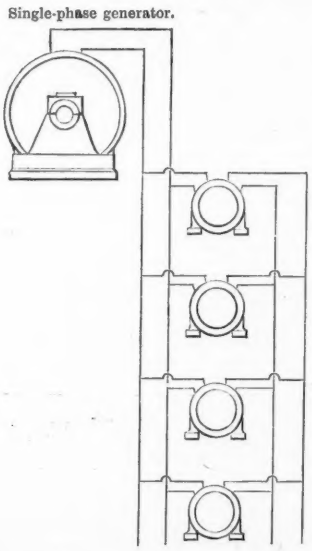


Fig. 5.

a stator so wound that the current density per centimetre arc followed approximately the sine law as shown in fig. 6, we should get as a resultant magnetic field a large forward travelling sinusoidal distribution, and superimposed upon a

similar distribution of small magnitude and backward direction.

If, however, our stator is evenly wound the current density per cm. arc will be that represented by the square curve in fig. 6.

And now we see how the harmonic components of the field

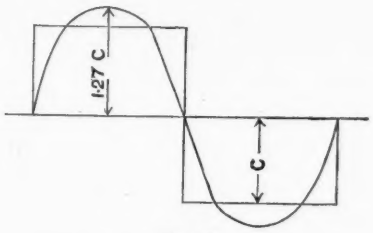


Fig. 6.

creep in. We may split up the square curve into a series of sinusoidal terms as follows :—

If the amplitude or maximum current density per unit circumference is C, it may be exactly represented by

A bipolar sinusoidal distribution of amplitude 1·27 C				
added to a 6-polar	"	"	"	$\frac{1\cdot27}{3}$ C
" 10-polar	"	"	"	$\frac{1\cdot27}{5}$ C
" 14-polar	"	"	"	$\frac{1\cdot27}{7}$ C

&c., and in precisely the same way as we have treated the fundamental, so might each of the harmonic terms be treated until we had obtained a sufficiently near approximation to the truth to satisfy ourselves.

Each harmonic component of the stator current curve has two corresponding harmonic components of the resultant field, each of which components rotates forward or backwards as the case may be with a speed proportional to the reciprocal of the number of poles.

If, then, the rotor be running anywhere near synchronism it will be running far beyond the synchronous speed of the harmonic fields, but whenever such is the case the motor is acting partly as a generator pumping back power into the supply mains.

We see, then, that all the harmonic components of the field are detrimental, producing backward torques, and deducting from the net output of the motor, and decreasing the efficiency of the same. At a speed near synchronism, however, their backward effort is but small; take, for example, the first harmonic forward component. The current wave in the rotor is approximately one-third of the fundamental, the C^2R loss will therefore be as 1 : 9, and if the rotor be running with a slip of 6 per cent. the relative slips of these two waves will be as 6 : (66·6 — 6), consequently the relative torques as 1 : $\frac{1}{90}$.

This, however, is only true when the rotor is running near synchronism, for as the speed falls off the torque due to the forward fundamental term decreases, while the backward torque due to the first harmonic forwardly rotating component increases, and, in fact, it is possible that, under certain conditions of design, and when working with squirrel cage rotors, when the rotor has slowed down to nearly $\frac{1}{3}$rd of its true speed, these two torques become equal and produce a point of inflection or niche in the torque-speed curve, into which the motor may drop and exhibit every appearance of stability.

The same thing happens to a modified extent at $\frac{1}{5}$th, $\frac{1}{7}$th, &c., of the true synchronous speed, and it is possible with other distributions of the stator windings that such niches or flattenings on the torque-speed curve may occur at $\frac{1}{2}$, $\frac{1}{4}$, &c., synchronous speed.

This principle of harmonic fields must not, however, be carried too far, for we must remember that with a finite number of rotor and stator windings, the above-mentioned waves of current must necessarily be discontinuous in their form, and, moreover, the field in the air-space must also be irregular owing to the spaces occupied by the copper conductors virtually dividing the rotor and stator into a large number of teeth from which tufts of magnetic lines project radially across the air gap, so that if the pole pitch of any given harmonic be at all comparable with the hole or slot pitch in rotor or stator, we have already arrived at a limit beyond which it would be absurd to push the method explained above.

(*To be continued.*)

CALLENDAR AND GRIFFITHS'S RESISTANCE BRIDGE.

We have received from the Cambridge Scientific Instrument Company details of apparatus manufactured by them from the designs of Prof. Hugh Callendar and Mr. E. H. Griffiths.

The first is a Wheatstone bridge of somewhat peculiar construction, and is the outcome, we believe, of the work done by the designers on platinum thermometry. The platinum thermometer affords means of measuring temperatures so greatly in advance of anything possible with mercurial or air thermometers that it opens up a whole field of new observation. These instruments are capable of indicating extremely minute temperature changes, they take the temperature of the surrounding medium with great rapidity, the exposed part is simple and inexpensive, they are not easily injured, they can be used in almost any place or medium, and they are free from errors of fatigue. Their principal limitation is the degree of speed and accuracy possible in getting the resistance, and they are consequently directly dependent on the Wheatstone bridge and resistance box. The details of the construction of these naturally receive the attention of anyone working with platinum thermometers, and Messrs. Callendar and Griffiths designed a convenient and accurate bridge for their work which they think will be generally useful.

The apparatus does not differ in principle from an ordinary slide wire bridge, but many modifications of the ordinary details of instrument making are introduced, some of which are of very great value. The principal points are the following:—Of the two circuits between the battery terminals that constituting the bridge consists only of two coils formed of two equal wires wound together on one frame. All measurements are made with an even bridge ratio, and no complications of any kind are introduced into this part of the circuit. The equality of these two coils can be checked and adjusted by the observer, so that no error in measurement should ever be due to this part of the apparatus. The other circuit between the battery terminals consists of four parts: the resistance to be measured, which we shall refer to as R, the scale wire and slide, the standard resistance box, and an arrangement for introducing a small resistance for balancing the connecting leads of R. The invention of the designers appears principally in the resistance box, and in the arrangements of the scale wire and contact slider.

The resistance box consists of 11 coils, having resistances of ·05, ·1, ·2, &c., ohms, ascending by multiples of 2 up to 51·2 ohms, amounting in all to 102·35 ohms, and adjustable to any lower value within ·05 ohm. This arrangement has a certain small advantage. Such a set contains the smallest number of coils with which the same range of adjustment can be made, but it is inconvenient. Certain other advantages are claimed for it, and principally the ease with which the relative values of the coils can be checked. In this respect a series 1, 2, 4, 8, &c, has no advantage over 1, 2, 3, 4, 10, 20, 30, 40, &c., and is inferior to the dial system, which consists of 10 coils of value 1, 10 coils of value 10, and so on. The coils themselves are made of bare platinum silver wire, wound on open mica frames. They are annealed after winding and mounting by heating them red hot with a current of electricity in an atmosphere of carbonic acid, and are placed permanently in a tank of paraffin oil, which can be stirred freely by a handle at one end. It is on the construction of these coils we think that the designers are especially to be congratulated, and where the length of wire is not too great to be wound on a mica frame it undoubtedly constituted a very great advance on the usual method of winding silk-covered wire on a solid support. In the same paraffin bath, and in series with the 11 coils described above, is an

extra coil of ·01 ohm, used to calibrate the scale wire, and a coil of 1 ohm, used for a special purpose with platinum thermometers. The two bridge coils already described are wound in the same way as the others, on a single frame, and are placed in the same oil bath.

Instead of an ebonite slab, white marble is used, which is said to be equally as good an insulator as ebonite, and free from its defects. It does not form a film of sulphuric acid, its coefficient of expansion is less, and its white surface shows the presence of dirt. It is, of course, much less convenient for mounting brass work upon.

The pamphlet before us emphasises the arrangement of the taper plug sockets, which differs from common practice in that each socket is formed of an independent pair of brasses, so that the fit of any one plug is not affected by the others.

In cases where the fit of ordinary plugs is not good enough to be beyond suspicion, we should prefer capped plugs. When mounted on ebonite slabs, the very elasticity of the ebonite seems to assist the effectiveness of a taper plug, which appears to bite better than when mounted on a more rigid material.

The ordinary wooden box is replaced by a copper and asbestos tank, which at once serves as an oil bath, helps to keep all the oil at one temperature, and retards exchange of heat with the outer air.

The scale wire and sliding contact have received much attention, and the arrangement adopted is clearly very convenient. The wire itself is calibrated, so that the divisions represent definite resistances, and the true zero point can be ascertained and set within a few minutes. The total resistance of the scale wire, with its connections and ends, is of no importance, for, since we are working with an even bridge ratio, the only quantity that concerns the result is the difference between, not the ratio of, the resistances of the two parts into which it is divided by the contact point. To know this we only require the exact centre, which be readily fixed, and the resistance per unit of length of the exposed contact wire, which can also be obtained readily, and checked at any time by means of the calibrating coil of the resistance box. Then when an exact balance is obtained by adjusting the slide, the resistance, R, is simply the sum of the resistance open in the box, and twice the resistance of the wire between the slide contact and the central point. The pamphlet justly claims that the arithmetic of this system is very simple.

The form of the sliding contact itself is ingenious, and should work well. It has a fine adjustment screw, and its position is read with a vernier to 10^{-5} ohm, *i.e.*, to ·0008 inch, a degree of exactness that one cannot help suspecting. The whole apparatus is placed under a glass cover, and the connections and general mounting are solid and workmanlike.

Now, while we have no doubt that this apparatus is decidedly superior to many instruments hitherto constructed, we are not at all sure that it is to be recommended for general use. Exactly the same degree of accuracy may be obtained more simply by balancing successively the resistance to be measured, and a known resistance box used as a standard of reference on the same sensitive, but not necessarily accurate, slide wire bridge, using this merely to ascertain the difference between the two quantities. This substitution method may be inconvenient with thermometry, as it involves two operations, while the Callendar and Griffiths bridge involves only one, but for most purposes this would not matter, and in many cases will not be appreciably more troublesome. It has the advantage that no great accuracy is required in any place except where it is absolutely essential; *i.e.*, in the values of the reference coils. To take a parallel case:—For fine weighing one does not ask for a balance whose arms are of the same length; sensitiveness is the only quality required, and it would be a waste of time to try to construct balances in which masses could be compared in different pans to an extreme degree of accuracy. For this class of work in electricity we think the bridge and the reference coils should be treated as quite distinct pieces of apparatus, as are a balance and a set of weights. The only important quality in one being sensitiveness, and in the other accuracy of adjustment. In measuring resistances, the substitution method has many advantages that need not be referred to here, but it may be pointed out that by placing the scale wire between the bridge coils, all measurements are read directly from the scale in percentages. Thus, in comparing A and B, A is found to exceed B by 7·5 parts in 10,000, and not by any absolute difference in ohms. For many purposes this is the most convenient form in which to take the figures. The entire elimination of all thermo-contact effects is not the least important part of a substitution method. In making these observations we recognise that the more important features of Messrs. Callendar and Griffiths's design are fully as valuable in a substitution method as in a direct reading one. We shall return to other apparatus in a future article.

A PHASE OF THE QUESTION OF ELECTRICITY TARIFFS.

One of the consequences of the use of the Brighton tariff frequently is, that early-closing shopkeepers pay a higher rate for current than their neighbours who are long-hour consumers.

This circumstance arouses much discontent among the former class, who are not slow to give expression to their alleged grievances. Their arguments, however, are as weak as their complaints are clamorous.

Unfortunately Town Councils are frequently largely composed of influential shopkeepers who close early, and the sub-conscious effect of their electricity bills (on which they get no rebate) leads them to the conclusion that the system is erroneous.

The small minority of non-profitable consumers joins them in their noisy opposition to a differential tariff, and together they try to urge that an all-round price would increase the prosperity of the electricity works.

A town council is a changing body, and its members may sometimes be tempted by the spirit of opportunism to silence the "conscientious objectors" by adopting a uniform tariff, thinking that in this way the success of their undertaking will be assured.

The opposition shown to the demand indicator system of charging in its early stages in some towns is due entirely to a small percentage of the consumers who get an unmerited consideration because of their loud-voiced grumbling.

Blackpool offers one of the best instances of how to deal with this question.

The result of the adoption of the system of rebate was, that 8,200 lamps were disconnected in one year, but Mr. Quin, who pursued a vigorous and consistent policy throughout, had the satisfaction of seeing them replaced by 9,914 additional lamps, which had a very much higher consumption of electricity per lamp.

The discontent created was practically confined to those customers who would never have obtained a rebate under the new scale, and who were, therefore, no source of profit to the station.

While the unprofitable consumer inclines to violent agitation for reducing the price, the long-hour user, who benefits by the sliding scale, as a rule is silent. In Belfast, however, such has not been his attitude, and a deputation of long-hour consumers, which appeared before the Town Council on March 1st, gave some very sound reasons why the Brighton tariff should be maintained.

The Council gave due weight to their representations, and resisted the specious arguments of those who wished to establish a uniform price. The rates are now 7d. for one hour, and 2d. afterwards.

A short account of the speeches made by the deputation and the recommendations of the Council are appended.

The deputation appeared before the Council with regard to the charges for electric current on 1st inst.

Mr. B. W. Walpole said they had come as a deputation from the long-hour consumers of electric current. Owing to the enlightened policy of the Corporation, some six months ago, when they introduced the Brighton system of charge, they had been able to adopt electric current for lighting and motive power in their warehouses, shops, and factories. Prior to that decision six months ago, they were not in a position, from an economical point of view, to take in the supply, for, being long-hour consumers, the all-round system of charge made its use prohibitive to them. The wisdom of the Corporation in introducing this new system of charge had been demonstrated by the success of the undertaking in the

past six months, for they understood that, notwithstanding the fact that a large amount of the past year's revenue was required to pay interest and sinking fund on a capital outlay required for the new station, the undertaking had paid its way. They learned with pleasure that the electric committee proposed to recommend the Council to charge only 7d. a unit for the first hour, instead of the first hour and a half as heretofore. This was a most important concession, which would reduce the price to both the short and long-hour consumers, and he felt that the short-hour users were beholden, first to this Corporation for introducing the new form of charge, and secondly, to the long-hour consumers, to whose support this important concession was due. To the minds of the deputation the new system of charge, viz., 7d. for the first hour, and 2d. for the succeeding hours, was a most equitable one, and they had learned with feelings of apprehension that the short-hour consumers were agitating with a view to having an all-round charge reinstated. A resumption to the old system of charge would increase the cost to long-hour consumers to such an extent, that they would be forced to go back to the older forms of lighting and power generation, and the undertaking would thus lose a type of consumer who had assisted so materially the success of the past year. The Brighton system of charge was essentially the fair and equitable one, and had been recognised by the majority of the principal towns in the United Kingdom.

Mr. R. Bell added a few words, and said that if a retrograde movement was adopted, those who now used electric light would have to resort to gas. He might take that opportunity of expressing how pleased they were to see Mr. Jaffé occupying the chair of Chief Magistrate in succession to Sir James Henderson, and they hoped his Lordship would not be satisfied with one year.

The Lord Mayor said the matter would have the serious attention of the Corporation.

The deputation withdrew.

The minutes contained reports by Councillor Andrews, Councillor Wheeler, and Mr. V. A. H. M'Cowen regarding the charges for electric current.

Councillor Andrews moved the adoption of the minutes, with the addition, "That the reduction of the time period on which the initial price of 7d. per unit was charged be extended, so as to include the charge for current used for motor purposes." In the report, the reduction from an hour and a half to one hour read as if it were only intended to apply to current that was used for lighting purposes. The intention of the committee was, that the reduction should apply to all current that was used, both for lighting and motor purposes. The proposed alteration would mean a reduction to consumers who used electric light for 182 days in the year for one and a quarter hours of 15·8 per cent. on the bills of last year, and those who used it for one and a half hours would have a reduction of 24·3, for two hours 21·8, and three hours 18·9, so that this reduction from an hour and a half at a high charge to an hour would be a material benefit to the consumers of current at large.

Supply companies usually maintain a uniformity of policy and when convinced that a principle is commercially sound are not inclined to give way to selfish external influence. While it is more difficult to ensure this in the case of a municipality, it is none the less necessary for electrical engineers to steadfastly uphold what they know to be the best interests of their undertakings.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

4,276. "Improvements in automatic potential regulators for dynamos." N. Browne. (The Tirrill Automatic Potential Regulator Company, U.S.) Dated February 27th. (*Complete.*)

4,283. "An improved electrical sock." G. Williams. Dated February 27th.

4,312. "Improvements in electric welding and apparatus therefor." O. Imray. (G. L. Thompson Manufacturing Company, U.S.) Dated February 27th.

4,313. "Improvements in alternating current motors." M. Deri. Dated February 27th. (*Complete.*)

4,318. "Improved electric signalling device for railways." L. Calisch. Dated February 27th.

4,327. "Improvements in electro-pneumatic controlling system." G. Westinghouse. Dated February 27th. (Date applied for under Patents, &c., Act, 1883, Section 103, August 20th, 1898, being date of application in United States.)

4,360. "Improvements in or relating to apparatus for use in electric traction on the conduit system." E. Vedovelli and C. Priestley. Dated February 28th.

4,370. "A rise and fall pendant or electrolier for electric light." P. Stevenson. Dated February 28th.

4,409. "Automatic telephone exchange system." A. Heiny. Dated February 28th.

4,415. "Improvements in apparatus for use in electro-plating." H. H. Lake. (H. R. Boissier, U.S.) Dated February 28th.

4,416. "Improvement in direct current systems of electrical distribution." B. G. Lamme. Dated February 28th. (Date applied for under Patents, &c., Act, 1883, Section 103, August 4th, 1898, being date of application in United States.)

4,417. "Improvements in or relating to conduits for electric conductors." F. Jones and F. A. Pocklington. Dated February 28th.

4,442. "Improvements in the manufacture of accumulator plates." W. Majert and F. Berg. Dated March 1st. (*Complete.*)

4,455. "Improvements in and appertaining to electric street tramways." R. Riley, T. Winstanley and S. Riley. Dated March 1st.

4,486. "Improvements in electric signals and alarms." J. E. Kelly. Dated March 1st.

4,496. "Improvements in or relating to electrical contact breakers." G. Bowron. Dated March 1st.

4,498. "Improvements in and relating to telephonic apparatus." G. Blank and H. M. Salmony & Co., Limited. Dated March 1st.

4,512. "Improvements in and relating to perforators for use in connection with automatic telegraph transmitters." W. J. Murphy and G. Draper. Dated March 1st.

4,528. "Improvements in electric bells for cycles and other vehicles." A. R. Gould. Dated March 1st.

4,595. "Improvement in apparatus for working tramways by electric power." R. H. Lendrum. Dated March 2nd.

4,598. "Protecting the overhead wires of electric tramways, and construction of trolley or current collector adapted thereto." J. Sturgeon. Dated March 2nd.

4,605. "Improvements in electric motor controllers." A. D. Stevenson and A. V. Gifkins. Dated March 2nd.

4,632. "Improvements relating to the operation of electric motors at different speeds." C. J. Reed. Dated March 2nd.

4,633. "Improvements in method of, and means for, operating electric motors." C. J. Reed. Dated March 2nd. (Date applied for under Patents, &c., Act, 1883, Sec. 103, August 17th, 1898.)

4,683. "Improvements in automatic switches for alternating electric current circuits." H. F. Parshall. Dated March 3rd.

4,684. "A method of, and apparatus for, regulating the voltage of electric currents." H. F. Parshall. Dated March 3rd.

4,699. "An improved ceiling rose for electric lights and the like." H. F. Clayton. Dated March 3rd. (*Complete.*)

4,727. "Improvements in, and connected with, electric tramway and railway conduits." A. M. Taylor. Dated March 3rd.

4,774. "An improved electrical cut-out or fuse." F. W. Heaton and H. Smith. Dated March 4th.

4,778. "An improved electric therapeutic apparatus." P. J. Wilkinson and C. P. L. Tithebley. Dated March 4th.

4,788. "Improvements in, or connected with, electric arc lamps." W. J. Davy. Dated March 4th.

4,801. "Improvements in, and connected with, resistance switches for electric circuits." J. H. Holmes and F. Broadbent. Dated March 4th.

4,821. "Improvements in, and relating to, motor-suspension for electrically-driven vehicles." A. G. Brookes. (T. Stort, Germany.) Dated March 4th.

4,822. "Imppovements in, and relating to, motor-suspension for electric automotor vehicles." A. G. Brookes. (T. Stort, Germany.) Dated March 4th.

4,838. "Improvements in portable electric primary batteries." C. H. Cole. Dated March 4th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. (*in stamps*).

1897.

246. "Improvements in means for adjusting electric light carbons" A. H. Gibbings. Dated January 5th, 1897. *Arc Lamps.*—In renewing carbons, they are set straight by a clip which holds them in line till they are secured, and is then removed. The clip may be a piece of sheet metal curved to fit the carbons, and may be sprung open. Or two semi-circular blocks bored to fit the carbons, are connected by hinges or dowel pins and spring fastenings, so that they can be closed on the carbons. 2 claims.

902. "Automatic electric marine sounding apparatus." J. F. Babcock. Dated January 12th, 1897. A hollow cylindrical casing, provided with a cup-shaped weight and fin, is carried by the cable, dome, and bale on which the dome and casing are pivoted. The cable, besides containing the insulated leads of a battery and bell, has strengthening wires, the ends of which are secured in the dome by Babbitt metal. By this means no strain is thrown on the leads which are coiled round the bale, pass into and partially through it,

then are again coiled about it, and then pass to the contact plates. The upper of the contact plates is fixed, the lower is secured to a sliding rod provided with a weight just sufficiently heavy to overcome the coiled spring and separate the plates. The rod passes through two India-rubber packing rings of special dome shape with a collar to clasp the rod and flanges. When the weight strikes the bottom, or the sinker lies on its side, the spring acts and closes the bell circuit. 4 claims.

1,150. "Improvements in portable electric railways with overhead conductors." A. Koppel. Dated January 15th, 1897. Electric railways and tramways, portable, with overhead conductors. Permanent way, conductors, supports for. The supports for the conductors are rigidly or detachably connected to the sleepers or rails. The figures show some of the forms that may be adopted; figs. 4 and 8 being perspective views, and figs. 18 and 22 plans. 5 claims.

1,434. "Improvements in or relating to means for operating the electric road switches on electric railways." J. F. McLaughlin. Dated January 19th, 1897. Relates to improvements in the means for supporting and controlling the magnets carried by the vehicle to operate switches in the roadway, such as described in specification No. 15,686, A.D. 1895. At each end of the vehicle a magnet is mounted on a carriage running transversely on the vehicle, and these carriages are connected by links and bell cranks so as to move in opposite directions when worked through a shaft, which may be geared to the driver's switch. By this means the magnets are put into position so as to successively open and close the road switches when the vehicle runs forwards or backwards. In order to properly align these magnets over the switches when rounding curves, the lever mechanism replaces a simple bell crank. Pilot wheels by means of connections through the rock shaft work a bent lever, mounted on the arm and connected to the tail end of another arm of the bell crank above referred to, only, in this case, the arms are in one piece. By these connections the arms and the carriages are operated both by the driver and by the pilot wheels. The latter are kept on the rails by levers and springs, or by winding their axles with a coil so as to render them magnetic. 5 claims.

1,657. "An improvement in the electro-deposition of metals and alloys." G. A. Webb and W. A. Thoms. Dated January 21st, 1897. Depositing metals or alloys containing phosphorus. The metals deposited may be platinum, iridium, palladium, ruthenium, and the like heavy metals, copper, tin, gold, silver, zinc, cadmium, nickel, cobalt, iron, lead, bismuth, or antimony, while the alloys may be mixtures of any of these. Consists in employing an anode formed of the desired metal or alloy and containing phosphorus, or an electrolyte containing a salt of the metal or alloy and phosphorus, or employing both anode and electrolyte containing the desired ingredients. The phosphor metal or alloy may be deposited upon metals or alloys of metals or other suitable materials. Examples are given of solutions, quantities, temperatures, and strengths of current for some particular cases. The electrolyte may be formed electrolytically or otherwise. 1 claim.

1,800. "An improvement in or connected with electric clock movements to record the time by electricity." W. H. Stockall. Dated January 23rd, 1897. Relates to electric clocks. The circuit making and breaking device consisting of a pair of cams mounted on the minute spindle of the regulating clock, on which rest levers carrying contact makers. A cam can be placed in front of the other to any desired amount to regulate the length of time during which contact is made. The current excites the electro-magnet which then attracts the armature. The latter is pivoted and carries an adjustable counterweight. Its movements are regulated by screws, the latter of which has an India-rubber or other spring buffer. An arm secured to the armature carries the pawl, which rotates the ratchet wheel when the armature swings away from the magnet. A second arm lifts a pawl gearing with a second ratchet wheel when the armature is attracted. A pawl engaging with the ratchet wheel to prevent back-lash. Slight modifications may be made in the receiving mechanism just described. 4 claims.

2,291. "Improvements in insulating frames for electrodes." M. Engl. Dated January 28th, 1897. Relates to an insulating frame for holding the electrodes. It consists of two rows of rods or strips united by pieces so as to form a frame in which are placed the electrodes preferably covered on one or both sides with an insulated perforated sheet. The frame may be made out of two plates with slots cut in them so as to provide spaces for the electrodes. 3 claims.

2,478. "Improvements in electric battery cases to render the contents of the cells unspillable; to facilitate the introduction of the electrolyte into the cells; to enable the level of the liquid to be easily ascertained; and to facilitate inspection of the interior." G. Fabbro. Dated January 30th, 1897. Relates to the cases or cells of portable batteries. The case is preferably of ebonite and contains one or more compartments, according to the number of elements in the battery. The cover is formed with triangular spaces to be filled with sealing composition. A covered cup with pin holes allows the escape of gas while preventing the overflow of the electrolyte. The hole in the cover facilitates the sealing of the internal parts in order to isolate the cells from each other. The cells are filled with liquid through the holes, closed by ebonite plugs. The terminals are fixed, connection being effected with the electrodes through chambers. 3 claims.

2,790. "Improvements in electric furnaces for use in the manufacture of calcium carbide, applicable also for obtaining metals from their salts." L. Bresson and P. Pacotte. Dated February 2nd, 1897. (Date applied for under Patents, &c., Act, 1883, Sec. 103, September 15th, 1896, being date of application in France.) Relates to a small furnace, applicable for making calcium carbide or obtaining metals electrolytically. A thin graphite crucible is packed with magnesia, asbestos or other insulator in a metal box which is supported on trunnions and can be turned over by a hand wheel to remove the products. The crucible is in contact with a copper conductor, and serves as one electrode, the other being one or more carbon rods. These may be supported by a rack geared to an electric motor, through which part of the furnace current passes so that the motor tends to lift the rods. To enlarge the heated area, polyphase currents may be supplied through the separate carbons, or the furnace or carbon may be rotated. In making carbide, to prevent carbon being burnt out of the materials before the line is acted on, the mixture is compressed into balls of 1—1·5 cm. diameter, without an agglomerant; only a small excess of carbon is necessary. These may be fed mechanically. 3 claims.

2,904. "Improvements in perforators for use in connection with automatic telegraph transmitters." F. L. Muirhead. Dated February 3rd, 1897. Perforators for the paper strips of automatic telegraph transmitters are arranged with a case containing levers controlled by the keys for operating the fingers for the punches and the pawl through the slide of the paper feed wheel. The punches and their slides are mounted on a base adjustably secured to the case by screws, and are capable of easy removal. The rear ends of the punch rods are so bent that the fingers strike at a uniform distance from their fulcrum. The feed wheel is adjustable by slots and screws. A tension guide roller and a press lever for the paper is provided. 5 claims.

3,053. "Improved separator for the plates of secondary batteries." E. S. New. Dated February 5th, 1897. Separators are made of two plates of insulating material, in which are cut longitudinal slots for the plates or electrodes, which are thereby held above the bottom of the cell. The plates are united by cross bars. 1 claim.

3,346. "Improvements in secondary batteries." C. Payen. Dated February 8th, 1897. The electrodes consist of prisms, which may be of various forms enclosed in perforated conducting sheaths which may be of pure antimonial lead. The prisms are of crystallised lead or peroxide, and are so grooved, &c., as to provide both a large surface of contact with the sheath and a large surface exposed to the electrolyte. The sheath being without perforations at the lower end, retains powers, &c., resulting from disintegration and prevents short circuiting and leakage. 1 claim.

6,305. "Improvements in telephone installations and apparatus therefor." Siemens Bros & Co., Ltd. (Siemens & Halske.) Dated March 10th, 1897. Multiple board systems are arranged so that the connections for calling, testing, speaking, and indicator action are actuated by the removal from, or replacing upon, the switch lever of the plug; the point of the calling key also is used to reset the subscriber's indicator. 4 claims.

6,308. "Improvements in indicators for telephone exchanges." Siemens Bros. & Co., Limited. (Siemens & Halske, Germany.) Dated March 10th, 1897. Relates to indicators or annunciators for telephone exchanges. In a form shown, the drop indicator is fixed to the pivoted armature, which is mounted between the pole-pieces of the electro-magnets. One electro-magnet is in the subscriber's circuit and the other is in the exchange circuit, the indicator being lowered when the former and raised when the latter circuit is completed. In another form shown it is arranged as a ring-off drop. The pole pieces of the electro-magnets are formed by the inner ends of the soft iron yoke, to the middle of which is attached one pole of the permanent magnet. The other end of this magnet carries the armature and indicator, the upper surface of the armature being curved and fitting in corresponding recesses in the ends of the pole-pieces. The pole-pieces and the armature are normally polarised by the magnet, and the electro-magnets are arranged in series, the apparatus being operated by alternate currents in opposite directions. The arrangement of the pole-pieces and armature is adapted to prevent magnetic dispersion between the poles.

6,818. "An improved storage battery." J. Entwisle, of the firm of E. K. Dutton & Co. (C. T. Barrett, United States) Dated March 16th, 1897. The active material is fixed on and in a plate of pumice stone. The electrode consists of a plate of pumice stone with holes in it, in which is packed active material. The plate is also coated with active material, which is in turn covered with coke dust so as to make contact between it and the lead box, in which it is enclosed, the said box having slots and perforations in it corresponding to those in the casing. 10 claims.

18,719. "Improvements in supports for the current collectors of electric railways and tramways with overhead conductors." Siemens Bros. & Co, Limited. (Siemens & Halske, Germany.) Dated August 12th, 1897. Collectors for use with overhead conductors. The current-collector arm, counter-balanced by a weight, is pivoted on a lever, which in turn is pivoted on supports on the vehicle, and is also counterbalanced by a weight. Springs are thus dispensed with, and the arm will turn over automatically, as indicated in the diagram, when the vehicle reverses its direction. Stops then aid the counterweights in maintaining the collector in contact with the conductor. 1 claim.

1898.

16,213. "Printing telegraph." R. Kubler. Dated July 23rd, 1898. Relates to a telegraphic typewriter, the effect of which is the same as the ordinary type-wheel typewriter. Electric impulses produced by means of a contact bar and metallic pointer, forming the sender, are transmitted to the receiving apparatus, and produce the rotation of a type-wheel, the type of which, after being adjusted to the operative or printing position, is caused to effect the impression at the moment a somewhat longer electric impulse or a longer interruption of the electric current is effected at the sender end. As soon as the sign has been printed the type-wheel is returned to its original position. 2 claims.